RADIO, TELEVISION and HOBBIES

Volume 22. Number 12 **March, 1961**

TAX ON TAPE RECORDERS

I WAS somewhat astounded by a recent news report to the effect that professional musicians in Germany have demanded that a surcharge be placed on all new tape recorders and diverted to their special benefit. Their reasoning was that tape recorders are sometimes used by private individuals to make copies of commercial gramophone discs, thereby limiting the sales of such discs and the returns to artists therefrom.

Since there seems to be no easy way of distinguishing between those who do and those who do not make such copies, the proposal was that all should be made to contribute, per medium of the proposed tax.

If the position in Germany is anything like that in Australia, those affected would include large numbers of people in social, educational and religious groups who use recorders for just about everything but copying discs. In any case, the cost of tapes and the limited quality of "microphone copies" made on domestic machines is hardly an incentive to build up a tape library to the exclusion of discs; and, after all, that is what really matters.

But why stop at a tax on tape recorders? Some teenagers apparently lend discs to their friends and borrow in return, thereby making each disc serve a greater audience.

And what of the pernicious habit of having friends over for the evening to listen to your records, instead of forcing them to buy copies of their own? Surely this justifies a surcharge on radiograms generally, with a special impost on the high fidelity installations which are more likely to be "shown off."

Then again, I know of people who learn a tune by listening to a record and thereafter entertain their friends by performing it free at parties. This could be covered admirably by a tax on pianos and, of course, on the new electronic organs.

No one wants to see artists treated unfairly but, equally, no one wants to see them sustained by a tax which is only vaguely related to reality. This is one idea that we can hope will stay in Germany.

W. M. Williams

NEW COVER DESIGN

This month, your "Radio, Television and Hobbies" has a new look, with its re-styled cover design and four-colour cover picture. It's part of our plan to make the magazine bigger, brighter and better, both as a technical journal from the readers' viewpoint and as a show-window for the Australian electronics industry.

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COVER PICTURE

Taken some time ago by one of our staff photographers, the picture catches what has since become a familiar scene in Melbourne — a "taxi" service operated by light helicopters. Though we have material in view for several forthcoming covers, we will be happy to hear from readers or advertisers who have color transparencies available relating to technical subjects, and which may be suitable for reproduction. Transparencies should be not less than 2¼ inches wide and of suitable format.

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There are two reasons for choosing this particular point for the tunnel. It is roughly the narrowest point of the Channel but, even more important, is the fact that the geological formations are ideal for drilling.

Diagrams here show the location of the tunnel and a section along the route.

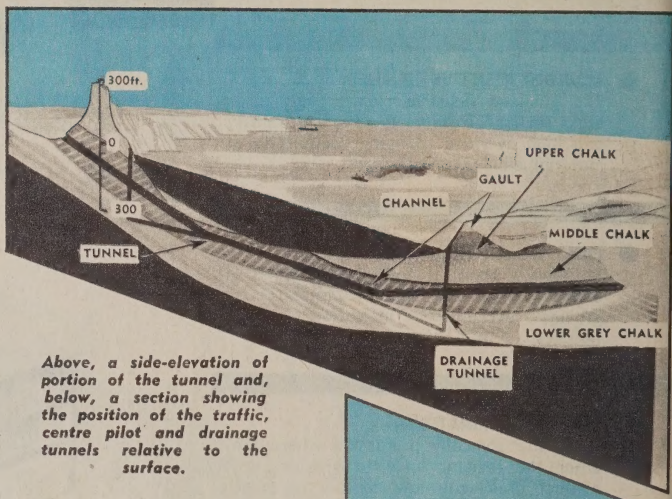
It had long been noticed that the geological formations on both the French and English sides of the Channel were the same, so it was reasonable to suppose that the same formations would be found under the water.

In fact, this has been confirmed by recent survey. Drillings were taken

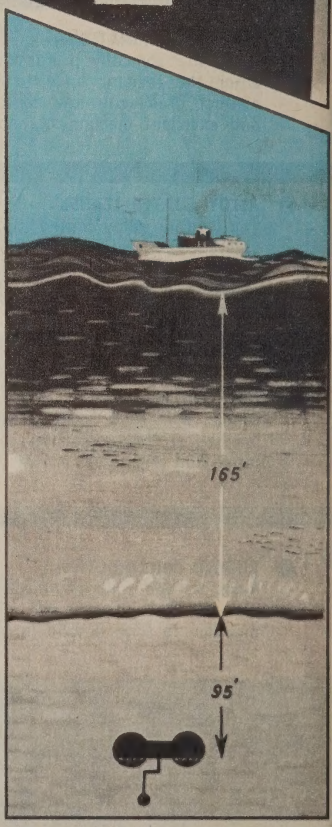
1961 or never?

THE CHANNEL TUNNEL

Engineering reports have established the practicability of building a tunnel beneath the English Channel, and much of the old-time prejudice against it has disappeared. And in the face of the economic advantages which would follow, many are suggesting that the job should be put in hand immediately.



Above, a side-elevation of portion of the tunnel and, below, a section showing the position of the traffic, centre pilot and drainage tunnels relative to the surface.



By R. N. Hadden

WORK on the Channel Tunnel will probably begin this year. When completed the tunnel will be one of the engineering wonders of the world comparable with the Suez and Panama Canals. Recently a team of engineers and economists prepared a report on the feasibility of the scheme.

The report was favourable, and now this has been done, only Government approval will be required to enable the scheme to go ahead.

In fact, since the engineering reports are favourable, and economists are convinced that the scheme is sound financially, it now awaits only the approval of the Governments concerned.

Before describing the details of the tunnel it is worth taking a quick look at the history of the scheme.

The first practical scheme was put forward by a Frenchman in 1856, and although many people were enthusiastic, the British Government of the day was opposed to the idea. For this reason nothing further was done.

Since then there have been several other proposals, not only for tunnels, but also for bridges, causeways and combinations of the two.

At one stage the tunnel scheme progressed as far as having two pilot tunnels drilled for a distance of a mile out from either shore. Although these pilot tunnels were abandoned, they did at least prove that the scheme is possible, because the leakage of water into them has been nil.

The chief reason that all the early proposals were abandoned was that the War Office was afraid that, if the tunnel was ever captured by an enemy, nothing could prevent invasion. While this was probably true at the time, it does not apply now, when landings can be made very easily by airborne troops.

As a further precautionary measure, it has been suggested that the power station, which will supply electricity for the tunnel trains, should be situated on the English side and should operate at a voltage and frequency not in use in France.

This would mean that any enemy wanting to use the tunnel would first of all have to connect up his own supply at the French end, and this would give sufficient time delay to enable it to be flooded.

The planned route of the tunnel is from behind the Shakespeare cliff, which lies between Folkestone and Dover, to a place between Calais and Boulogne, called Sangatte.

The overall length of the tunnel would be about 31 miles. This is somewhat wider than the Channel, but it includes about four miles on either side which would be necessary for the approach tunnels.

across the Channel and the cores were examined, the drill holes being filled up with concrete. It was found, as had been hoped, that the layer of grey chalk stretched all the way across.

The fact that the grey chalk is continuous is fortunate, because this is an ideal material through which to drill a tunnel.

As mentioned earlier, two pilot tunnels were drilled some years ago. These tunnels were in the grey chalk bed and no leakage has occurred since.

Another big advantage of drilling in grey chalk is that it is soft, so that blasting will not be necessary. In fact, it is soft enough to be drilled continuously by a giant rotating cutter.

MORE THAN ONE

Although the project is always referred to as "the Channel Tunnel," there will in fact be four tunnels. Two of these tunnels or tubes will be the main traffic ways, one will be the drainage header and the fourth the pilot tunnel.

The main tubes will each carry traffic in one direction, one northbound, one southbound. Because of ventilation difficulties only electric trains will be able to use the tunnel. Cars requiring transport will be carried on special rail trucks.

Although the building of this tunnel would be a tremendous feat of engineering it would not require the use of any techniques which have not been well tried already. The first stage of the construction would be the completion of the pilot tunnel.

The accuracy required in drilling this tunnel can well be appreciated when it is considered that it will only be about 10 feet in diameter, and the two halves will have to meet 15 miles from their starting points.

There is no doubt that the engineers will be relieved when the two halves do meet.

When the pilot tunnel has been completed work can be speeded up on the main tunnels as drilling can be carried out from intermediate points as well as the ends. A cross-section of the tunnel is illustrated.

As can be appreciated, a tremendous amount of spoil will have to be removed from the tunnel as drilling proceeds.

TWO SUGGESTIONS

Two interesting schemes have been put forward for removing it. In the first scheme it has been proposed that the chalk should be ground up as it is produced and then slurried with water. The chalk-water slurry would then be pumped directly upwards through bore holes to the Channel bed.

This proposal is definitely attractive, as no further handling would be necessary at the tunnel ends. However, there is an element of risk of flooding the tunnel by drilling upwards to the Channel.

The second proposal for removing the spoil is similar to the first, in that the chalk would be ground up to a fine powder. However, in this case it would be blown into pipes by air and so to the end of the tunnel. It is probable that this latter scheme would be the best.

As most of the tools used at the working face would be air-driven there would be plenty available for blowing the spoil down the pipe.

As the drilling of the tunnels proceeded they would be lined with steel or concrete sections in much the same way that the London underground railways are lined.

The proposed route of the tunnel, 31 miles overall.

The space between the lining and the rough wall of the chalk would be filled with cement grouting. This would ensure that the tunnel would be watertight and very strong.

In addition to the main tunnels and pilot tunnels a drainage tunnel would have to be drilled.

The drainage tunnel would be required, not so much to pump away seawater leaking in, but to remove the condensation which would occur on the cold sides of the tunnel.

This tunnel would be 7ft in diameter and would slope downwards from the centre of the Channel.

It is not thought that any special method of ventilation would be necessary, as the trains would produce no fumes. The fact that there are two tunnels interconnected would also help.

Further, the trains running through the tunnels would in themselves produce quite an interchange of air. If, later, it was found that some forced ventilation was desirable, then it would be a simple matter to blow air down the pilot tunnel.

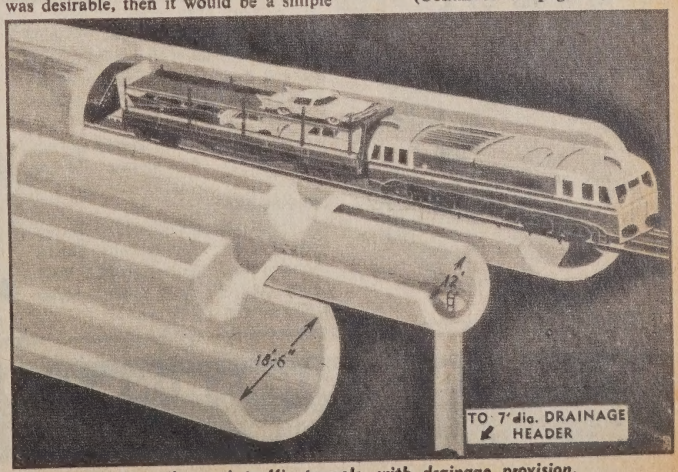
It may be thought that the pilot tunnel would not be of much use once the main tunnels were constructed, or that it would have been better to enlarge it to form one of the main traffic tunnels. However, quite a good case can be made for retaining the pilot tunnel in its original form.

The first reason is that it would greatly facilitate maintenance of the main tunnels. When it is considered that trains will run every 10 minutes for 20 hours out of every day, it can be seen how important it will be to get maintenance forces to the required location with the minimum delay.

Another advantage is that high-voltage cables could be laid to connect the French and English grid systems. This scheme has already been proposed, because the time of peak electricity demand in France is different from that in England.

Thus, England could supply France at peak periods and vice versa. It has

(Continued on page 44)



The pilot and traffic tunnels, with drainage provision.

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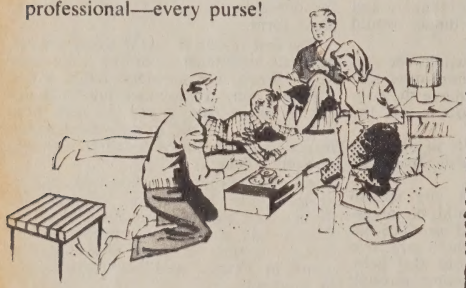

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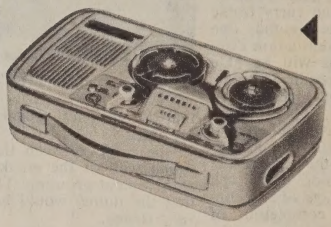

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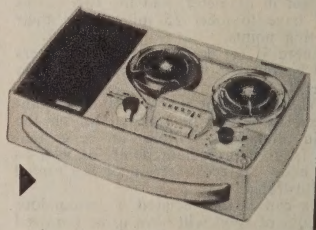

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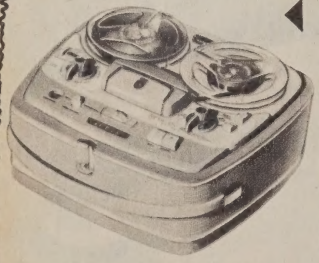

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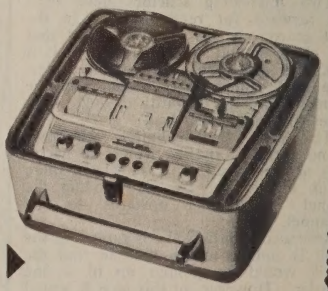

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FUEL SYSTEMS FOR PETROL ENGINES

How good is the carburettor in a modern motor car? Would fuel injection be better and, if so, why isn't it used? How does fuel injection work? These and similar questions are answerd in this article released by the Citreon Company of France.

FOR more than 15 years, Societe Citroen has been investigating fuel injection systems for petrol engines and has taken out a number of patents on the basis of this research since 1942.

Fuel injection devices are not new, of course, and attempts have been made over many years to correct certain inadequacies of the carburettor by various systems better adapted to the requirements for delivering fuel to internal combustion engines.

Until now, such injection devices have been applied only to very large engines. During the last war, some of the Junker and Mercedes aviation engines were fuelled by injection. More recently, Chevrolet in the United States brought out the 8-cylinder "Corvette" which develops 294 h.p. S.A.E. with a fuel injection system.

EUROPEAN EXPERIMENTS

Lucas in England and Bosch in Germany are working on injection processes for high-powered racing cars.

A few months ago, Citroen put into operation experimental pilot models of a 5½-ton truck equipped with a fuel-injection system. The experimental model is temporarily identified by the symbol 48-IE. To the present, however, Citroen is the first manufacturer in France to equip standard assembly line models with a fuel-injection system.

Fuel injection has a fully developed precedent in the diesel engine, with which most large trucks are equipped. The efficiency of the diesel is appreciably greater than that of the standard petrol engine (35 p.c. instead of 25 p.c. for the petrol engine and 10 p.c. for steam).

In the diesel, the oil fuel is injected by a high-pressure pump but this fuel is far less volatile than petrol and its combustion is controlled by different physical laws. Injecting petrol is not as easy as is the case with oil fuel.

PETROL PROBLEMS

This explains why, in spite of the well-established precedent set by the diesel, petrol injection systems have not as yet replaced the fuel vaporisation system utilised by the standard automobile engine carburettor.

In order to understand better the nature of fuel injection, we will briefly recall some the elementary principles of vaporisation. By comparing the two systems, we will be better able to appreciate the advantages which we are justified in expecting from the introduction of injection to petrol engine operation.

In a steam engine, the expanding steam drives either a piston or a turbine rotor. In both cases, the source of the heat of the working fluid is outside of the steam engine or steam turbine. They are "external combustion" engines.

In the petrol and diesel engines and in the gas turbine, the source of the heat of the working fluid is inside the cylinder. They are "internal combustion" engines.

These engines burn liquid or gaseous fuels such as diesel oil, petrol, benzol or acetylene, butane, and illuminating gas. Engines have been built which utilise solid fuels like coal dust and have shown very satisfactory efficiency in the laboratory.

Whatever the type of motor in question, the only way for producing this internal combustion is the introduction of the fuel in a closed space, the "combustion chamber," in which the abrupt expansion of the gases drives the piston back in the cylinder.

In order to arrive at this, it is not sufficient merely to deliver the fuel into the cylinder and ignite it. Combustion takes place only in the presence of air. Air is the comburent which permits the combustible to burn.

Liquid hydrocarbon fuels consist of carbon and hydrogen. The carburettor serves the double purpose of vaporising the hydrocarbon fuel and of mixing it with air in a well-defined ratio.

IN A WELL-DEFINED RATIO—here lies the problem of mixing air and fuel in a variable-speed engine, because the ratio must be changed constantly. A car runs fast or slow, turns, slows down or accelerates all the time. The carburettor adapts itself more or less well to all these variations.

VARYING CONDITIONS

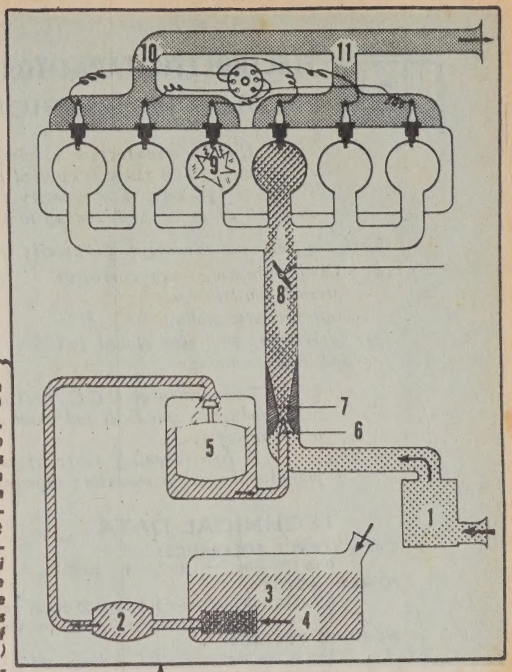
The engine must also be able to start and operate equally well in arctic cold or tropical heat and the temperature is not the only factor influencing carburettion because atmospheric pressure also plays an essential part in it.

Theoretically, 15.3 grams of air (12 litres) are required to burn completely 1 gram of petrol. Above or below this ratio, the mixture will still burn but with more or less difficulty and varying efficiency. It has been possible to achieve combustion of 1 gram of petrol in 28 grams of air (about 22 litres). This is the limit for "lean" mixtures.

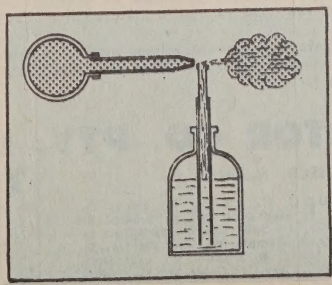
Combustion of 1 gram of petrol has also been achieved in 8 grams of air (about 7 litres). This is the limit for "rich" mixtures.

Above and below these limits, petrol will not ignite because the mixture contains either too much hydrocarbon or too little.

With this in mind, the essential importance of the carburettor is apparent.



Air is drawn in through filter (1) to venturi (7). Low - pressure pump (2) draws gasoline from tank (3) through filter (4) to carburettor (5). Jet (6) vaporises gasoline in venturi (7). Negative pressure in the venturi varies with setting of throttle valve (8) and mixture becomes richer or leaner. Mixture is drawn into the cylinder, compressed and ignited by a spark plug (9). Burnt gases escape through the exhaust manifold (10 & 11).



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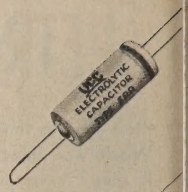

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WORKING VOLTAGE:
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PEAK RIPPLE VOLTAGE:
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C = Capacity in microfarads.
V = Working voltage.
I = Current in microamperes.

It should be noted that the leakage current given by this formula is the maximum acceptable for satisfactory performance and is normally less than half this value. All readings should be taken at 25°C. after applying the working voltage for five minutes; plus one minute for every month of shelf-storage.

TEMPERATURE:
The effect of temperature is important and it is closely related to and affects all characteristics. The ratings of type ER and ES electrolytic capacitors are based on a maximum temperature of 85°C. The temperature co-efficients of capacity and leakage current are positive whilst that of the power factor is negative.

SHELF-LIFE:
Idle storage has a deteriorating effect on the anode film and should electrolytic capacitors be stored for any length of time they should be re-aged. This is most easily accomplished by applying 90% of the rated voltage to the capacitor in series with a 10,000 ohm heavy duty resistor.

Initially due to a high leakage current the voltage applied to the capacitor will be low, gradually increasing as the current decreases. When the leakage current reaches the rated value the capacitor is ready for use.

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DETAILS OF INJECTION SYSTEM

The original carburettor, in the early days of the automobile engine, was simply a recipient containing petrol, occasionally equipped with a wick to speed up evaporation.

The air either passed across or bubbled through the volatile liquid and absorbed the vapours of the latter in the process.

In a very short time, the spraying system by means of a jet nozzle was introduced and this is the system still in use today. By moving away from the cylinder head, the piston draws air in the same way as a syringe. This air is guided through a tuyere to accelerate its speed.

This creates a negative pressure at the nozzle of the jet, the liquid fuel flows out of the nozzle and is vaporised in the airstream.

FIRST IMPROVEMENT

Early carburettors had only a single jet for all operating conditions. Addition of an idling jet brought a certain amount of improvement. Depending on the amount to which the throttle valve of the accelerator is open, petrol flows out of one or the other of the two jets and the mixture becomes leaner or richer as required.

In actual operation, however, the ideal gas-air mixture is far from being provided by this system. The carburettor normally has to be adjusted for an excessively rich mixture which involves a waste of petrol and constitutes the inherent weakness of the very principle of the carburettor.

It would obviously be possible to make the mixture leaner in order to come closer to the ideal ratio but the engine will then begin to overheat.

The carburettor has its specific troubles, one of which is the vapour lock. When the temperature rises too high, the petrol starts to boil in the fuel lines and turns into vapour so that the engine stops because it does not receive any fuel.

Icing-up of the carburettor occurs in traversing a moist layer of air in cold weather so that the jets become clogged by a sort of artificial snow.

Condensation takes place when the engine is stopped while the carburettor is excessively hot so that the petrol starts to boil. These vapours ultimately condense in the intake manifold. The mixture then becomes too rich and the "flooded" engine does not start up again.

HIGH SPEED PROBLEMS

The faster the engine runs, the more difficult it is for the air to pass through the venturi throat. The negative pressure increases with the speed of the engine so that the petrol flows out more quickly than the corresponding volume of air can enter. Consequently, the mixture becomes increasingly richer the faster we go.

Even the best carburettor cannot be perfect at all engine speeds and all loads. The most that we can expect is an approximate compromise between fuel economy and power output.

Some manufacturers therefore install multi-body carburettors. The Citroen DS-19 has a double-body carburettor, in which the smaller delivers fuel to the engine at low speeds and both work together at high speeds. Both in the DS-19 and the ID-19, the gas-air mixture is adjusted at all speeds to ratios as close as possible to the ideal.

At an average speed of 43 m.p.h., the ID-19 consumes only a little more than 8 litres per 100km and the "specialists" in fuel-saving come very close to 6 litres during economy runs.

Another difficulty of the vaporisation system is the unequal distribution of the mixture to all cylinders. In general, the cylinders furthest from the centre of the intake manifold receive less fuel than those in the middle.

This insufficiency can be partly eliminated by providing multiple carburettors, two for 4 cylinders or 3 for 6 cylinders. A 6-cylinder Lancia even has one carburettor for each cylinder. The problem then becomes one of synchronising the action of several carburettors.

It would seem that the carburettor has now reached a stage of development which cannot be further improved. The modern carburettor has become a miniature gasworks in which its small size only intensifies the complications that are the price of progress.

If we now want to advance on the way to more efficient ratios and automatic regulation, we will have to abandon established principles.

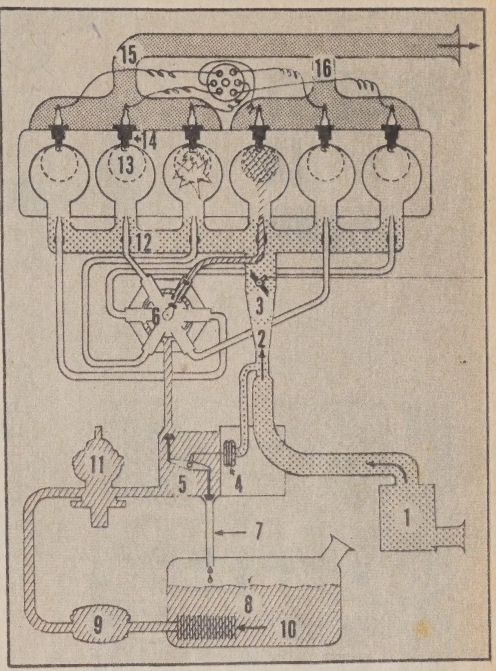
The principle of fuel injection is simple. Instead of drawing a mixture of air and petrol into the cylinders, the engine draws in only air and the petrol is introduced forcibly (under high pressure) into the combustion chamber at the proper moment.

CONSTANT RATIO

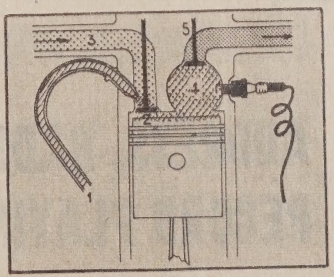
With the injection system, we have two valves (one for air and one for petrol) available for adjusting the gas/air mixture. By acting simultaneously on both of them, we can accurately proportion the mixture to given operating conditions.

Although this is simple in theory, the practical application is less so, because the driver has only one valve, the accelerator, which he can directly control. It therefore becomes necessary to co-ordinate the operation of the first valve with that of the second in such manner that the quantity of petrol injected at any given moment varies automatically with the opening or closing of a single valve, i.e. the amount of pressure applied to the accelerator pedal.

In the 6-cylinder Citroen truck, model

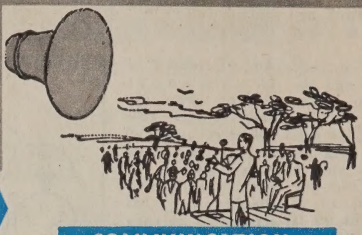


Air is admitted to cylinders through filter (1) and venturi (2). Negative pressure in venturi varies with setting of throttle valve (3). Diaphragm (4) controls a balance device (5), which meters the fuel. Low - pressure pump (9) draws petrol from tank (8) through filter (10) supplies it to high - pressure pump (11) to metering device and distributor (6). Excess fuel returns to tank through line (7). Cam of petrol distributor admits fuel to injectors (12). After compression, mixture is ignited in the turbulence chamber (13) by spark plug (14) and the burnt gases escape through the exhaust manifold (15 & 16).



Injection system of Citroen engine 48-1E. Petrol (1) is injected on the top of intake valve (2) just before it opens. Air is drawn in through pipe (3). Compression imparts turbulence to mixture in turbulence chamber (4) where it is ignited. Combustion starts in hot spot next to exhaust (5), terminates in relatively cool spot next to the intake valve.

FOREMOST IN SOUND . . .

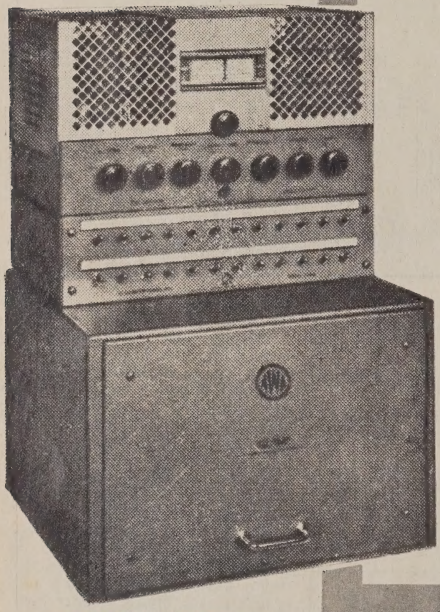


COMMUNICATION

ENTERTAINING

PAGING

INSTRUCTING



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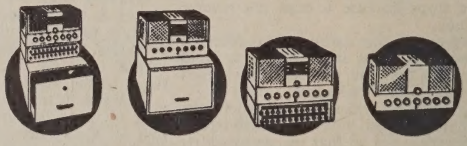

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48-IE, the petrol admission valve closes completely when the pressure on the accelerator pedal ceases and the engine draws in only air while the truck continues on its momentum.

When the 48-IE engine is idling, each injection represents only a maximum of 25 milligrams of petrol. The amount of time required per injection is as surprisingly little as the volume injected. When a 6-cylinder engine turns at 3,000 revolutions per minute, 9,000 injections take place during the same period of time.

COMBUSTION REGION

Under the 1942 patent of Citroen, the petrol is injected directly into the combustion chamber. Combustion starts in the hot region near the exhaust valve, progressively propagates itself from one rich zone to the next and terminates in the cool region next to the intake valve. This diminishes the tendency to detonation ("knocking or pinging") and makes it possible to raise the compression ratio for obtaining greater efficiency.

On the experimental truck models which are now in operation, a 1955 patent of Citroen has been utilised in which the mixture is obtained by injecting the fuel on the intake valve, just before it opens.

The Citroen patents offer a choice between two injection systems. The first produces very lean mixtures in all ranges so that fuel consumption becomes as economical as that of the best diesel engines. The second provides somewhat richer mixtures in all ranges which give a high specific output.

SUMMARY

The advantages of Fuel Injection are as follows:—

(1) The compression ratio, and consequently the thermal efficiency, can be raised without risking detonation.

(2) The intake manifold does not need to be preheated because condensation cannot occur. The intake air is colder and has less volume so that the cylinders draw in more air.

(3) The loss of power, produced by the resistance to the passage of the air in the narrow throat of the venturi, does not exist in the injection system.

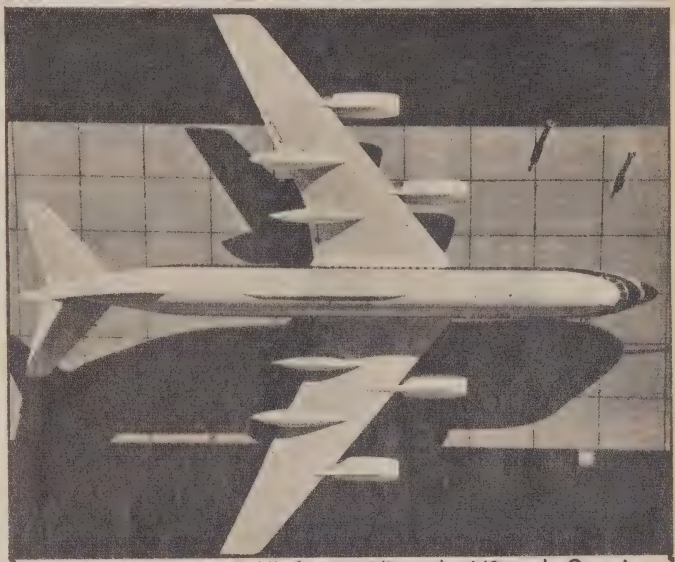
(4) Injection is the one certain means for furnishing the engine the correct quantity of petrol at all speeds so that the engine will be neither flooded nor strangled.

(5) Contrary to the carburettor, each cylinder, regardless of its position in the block, receives absolutely the same amount of the mixture as the others so that the engine runs smooth in all circumstances.

(6) When the engine is used for "braking," fuel savings are absolute because no petrol is delivered to the cylinders, but the advantage of "engine-braking" is retained, because the engine continues to draw in and compress air.

(7) Because the engine receives no fuel while the vehicle is "coasting," and because the lean mixtures result in complete combustion, the exhaust gases from the injection-fuelled engine are less noxious, discharge less carbon monoxide and pollute the air less than other types of internal combustion engines.

"CORONADO" IS WORLD'S FASTEST



Claimed to be the world's fastest airliner, the 640-m.p.h. Convair Coronado 990, will drastically cut flying time on the world's air routes. It could fly from Sydney to Europe in less than a day.

THE new aircraft is expected to go into service about the middle of this year. Seven of the intercontinental version have been ordered by Swissair for the Far Eastern Service between Zurich and Tokyo, and two by Scandinavian Airlines System for the service between Copenhagen and Tokyo. In addition, American Airlines has ordered 25 of the domestic version.

More powerful engines and improved aerodynamic features enable the Coronado to fly closer to the speed of sound than any other commercial jet.

The jetliner is the first to have a supersonic wing swept back at an angle of 39 degrees.

The speed capsules, the streamlined bodies on the wings, smooth the flow of air and reduce the air resistance. They account for the superior speed of the Coronado—up to 640 miles or 1,030 kilometres per hour—just a trifle below the speed of sound. The capsules, pointed at each end, are 24 feet long and up to two feet wide at their greatest diameter.

The engines are also a unique feature. The four General Electric engines, each with a thrust of 16,100lb, incorporate a large fan at the rear to pull by-pass air around the engine. The air ducts for this aft fan practically surround the basic engine, resulting in an engine pod almost six feet wide.

Increasing the volume of exhaust gases raises the engine thrust and improves fuel economy.

Mixing of the aft fan exhaust with the basic jet engine exhaust eliminates the need for sound suppressors. Convair engineers say the sound level in the passenger cabin will be quieter than that of any four-engined jet.

The giant new aircraft is almost 140 feet long and 40 feet high and has a wingspan of 120 feet.

Depending on seating arrangement, the Coronado can carry between 96 and 121 passengers.

Despite its huge size and weight (maximum take-off weight is 244,200lb), the plane will be able to land and take off in relatively short distances—well under 5,000 feet, for example, on a 1,000-mile trip.

(Editorial note: In addition to the system described here, and generally regarded the true fuel injection system, a number of modified systems have been tried, both commercially and privately. Many of these are what is known as "pressure carburettion" systems, in which the fuel is mixed externally and fed to the intake manifold under pressure. Admission to the cylinders is still controlled by the regular inlet valves.

Systems closer to true fuel injection are used in the Goliath and Mercedes, the latter in three models. Two of these, the 300D and the 220SE, are modified fuel injection systems in that, although the amount of fuel for each cylinder is individually metered, it is introduced outside the cylinder adjacent to the inlet valve. In the third model, the 300SL sports, fuel is injected directly into the cylinder.)

Stalactite and stalagmite formations in Karamu Cave, near Hamilton, New Zealand. The cave is one of the most inaccessible and least explored of the world's subterranean wonderlands.

Exploring Caves Is Not Just A Hobby

Modern speleology is no longer a hobby or an activity for the adventurous. Pursued on a scientific basis, it is contributing much valuable information in the fields of geology, archaeology and the search for radio active minerals.

by Calvin Walters

THE science of Speleology is the science of finding and exploring caves.

In recent years, there has been a great deal of activity and much publicity given to what the general public considers just another aspect of man's crazy urge for adventure.

It is true that there are many people who explore caves just for the heck of the thing, just as there are many others who climb mountains or explore the sea bed in a bathysphere or skin suit, or go up to dizzy heights in balloons, aeroplanes and gliders.

ALWAYS CURIOUS

People have always taken a great interest in a hole in the ground, or in a fence or in a circus tent.

Let council workmen erect a barrier and start digging a hole. Within seconds there are curious people watching and waiting. Every day one can see people peering through holes in a fence behind which some building operation is being carried out. Up-to-date contractors are now providing neatly cut out apertures to satisfy the demand by the idle curious.

The reason for peering through holes in circus tents or fences around football fields has an obvious monetary origin rather than idle curiosity.

It was not wholly idle curiosity which caused early man to become the first speleologist, for such he undoubtedly was.

His was a curiosity born of the need to find a safe place to live; a place where he could find refuge from the weather or from wild beasts, a hostile neighbour, a nagging wife, or a jealous husband.

Doubtless, however, there were many curious cavemen who, on seeing a hole in the side of a mountain simply said "Wonder what's in there," and proceeded to investigate.

Perhaps he was seeking a quiet place to woo his lady love. Such occasions sometimes inspire great courage and he would drag his lady by the hair into the cave. Courtship being otherwise not much different then as now, he might be greeted by a voice saying "Fair go, mate, find yourself another cave."

It is a fact that early man made extensive excursions into natural cave systems all over the world.

Evidence of his past presence is being found even today in the way of debris, deposits of the kitchenware, drawings upon the walls and so on. The latter habit persists to this day, as can be seen on railway tunnels, subways and so on.

Skeletal remains of early man are found in many of these caves. These are valuable to the archaeologist by providing grounds for intensive argument as to whether the remains are a million years old or only half a million.

Before we touch upon the formation of caves and the manner in which the modern speleologist works, it would be of benefit to give some idea of the practical uses of speleology so that you may decide whether it is worthwhile reading on or turning to "Let's buy an argument."

It must be borne in mind that, originally, cave exploration was carried out merely from curiosity and adventure.

During these excursions over the years, the scientifically minded discovered many things which helped solve some real problems, one of the most important being the irrigation of land over limestone regions.

Underground caves abound in limestone country and, where it has been the practice of sinking bores to find water, speleologists have been able to explore underground caves where much water often abounds. This type of water exploration is far less costly than boring at random. In addition, the speleologist is often able to advise as to the best location to bring the water to the surface.

In many places, particularly in Europe, speleologists are called upon to find underground water systems for the purposes of electricity supply.

An outstanding example of this is the development in Yugoslavia of hydro-electric schemes in the Dinaric Alps, a great limestone range which runs parallel to the Adriatic coast.

UNDERGROUND WATER

A peculiar feature of these mountains is that, between some of the ridges, are enclosed basins. These are not only fed with water from run-off, but also by underground water which comes up through the floor of the basin.

The water in the basin cannot get away except through a pothole in the limestone, so that a river can come up out of the ground at one side of the basin and disappear down a pothole on the other side.

After heavy rain, these basins become flooded, but the water gradually flows away down the pothole.

One particular basin over 2000 feet above sea level has a bottom area of 25 square miles and is capable of holding 400 million cubic yards of water if properly dammed. As damming of this nature means controlling the rise and fall

nto and out of the dam, the whole problem resolved itself around blocking up all the smaller potholes and controlling the flow through one big pothole capable of taking 200 cubic yards a second.

The idea was to surround this large pothole with a concrete cylinder 164 feet in diameter and 49 feet high, with suitable apparatus installed to control the flow after the dam became full.

Before this venture could be carried out it had to be first determined whether the bottom of the basin was impermeable enough to prevent water seeping away into the caverns in the limestone below.

It also had to be determined whether the floor of the basin, which was also the roof of caverns below, was strong enough to withstand the enormous weight of water proposed to be dammed.

SOLVED BY SPELEO CLUB

To find these answers to the problem, the Speleo-Club of Paris was engaged to go underground into the vast caverns. The report given was a satisfactory one, resulting in the commencement of a scheme, the problems of which could not have been solved by any other means than by Speleology.

Another application of speleology is the investigation of caves in inhabited areas to see whether any underground water exists and whether such water has any connection with the town's water supply.

In many European cities it has been the custom of disposing of refuse and dead animals by throwing them down potholes leading to underground caves. Because epidemics of certain diseases were traced to pollution of the water supply, speleologists were called in. They found that underground springs in the caves were connected with the water supply. The result was the complete banning of using these caves as rubbish dumps.

The geologist, using modern cave exploring equipment, finds fruitful information in caves. Here he can study the rock and sedimentary formations without the labour of digging, for in large caves the layers of rock are sometimes clearly defined, much more so than in the side of a hole dug by hand.

The search for radioactive ores has given great impetus to the science of speleology. In the vast underground caverns all over the world, geiger counters are ticking away in the hands of countless searchers. Modern equipment has enabled them to make safe and properly planned descents thousands of feet underground.

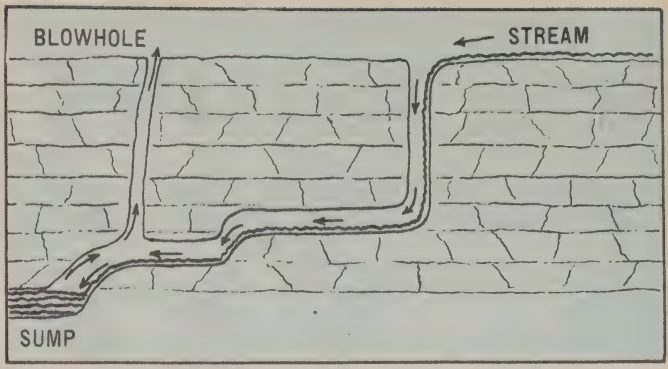
VALUABLE DATA

Likewise do scientists investigate cosmic ray phenomena, measurement of gravity, magnetic deviations and so on, all of which are adding to our knowledge of the wherefore of things.

Of course, proper attention is also given to the possibility of using such caves as refuges against radiation from the bombs they make from the uranium they may find in the same place.

In addition to the studies available to archaeologists, the zoologist and the entomologist finds fruitful study in underground caverns. Many of these are or have been inhabited by all kinds of animals, insects and creatures such as bats.

There are earthworms of various varieties, fungi, all sorts of flies, gnats, glowworms, spiders, beetles, mites, millipedes, shrimps, water lice, tadpoles, snails, and many others too numerous to mention.



An open air-circulation system, promoted by a heavy flow of water.

All these exist in a wide variety of environments at different light intensities, temperatures and degrees of humidity or dryness. Such environments exist according to the geographical locations of the caves.

Environment also has a profound effect on cave inhabitants, so that it is little wonder that scientists interested in this aspect have seized upon speleology as a new source of environmental information and study.

Caves are formed in all kinds of rock formations but, for our purposes, we will deal with the more widespread limestone cave formations similar to our Jenolan Caves in New South Wales.

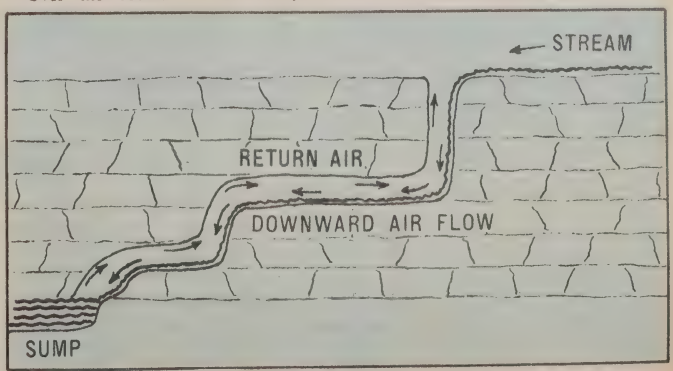
WATER EROSION

These caves are caused by the erosive action of underground water excavated originally by acid water making its way downwards from the surface through natural cracks and divisions in the strata.

In this way sufficient space has been eroded to allow the passage of underground streams. Over long periods of time, erosive action has caused the collapse of the roof and walls, thus giving rise to great caverns. The debris which falls from the roof and sides has been gradually dissolved or ground into fine gravel or dust and been carried away by the stream.

Over the course of time also, the

Not everyone relishes situations like this but it's part of a 3-mile trip underground to a lake in America's Marvel Cave, 300ft below the surface.



A closed air-circulation system, again involving a heavy flow of water.

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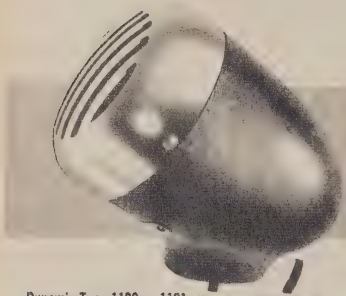

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Dynamic Type 1114 or 1115. Recommended for tape recording and general stage work. Styled for hand use or stand mounting. Frequency response, 100 to 10,000 c/s.

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HIGH ADVENTURE—UNDER THE EARTH'S SURFACE

Shattered limbs, perhaps death, await the cave explorer who misses a deep crevice like this, or who slips while trying to cross it. And remember the picture looks bright only because of the photoflash. The only light the explorer really has, is that from his head lantern.

stream finds its way through narrow gaps and folds of the rock, giving rise to passages. Anything which occurred to divert the flow of water such as earth tremors or falls of rock left the caverns and passages dry and accessible by several openings through which the speleologist may enter on his tour of exploration.

Inside the cave various and beautiful formations exist which are the result of seepages of water through the overlying strata. The most notable of these formations are, of course, the stalactite which hangs downwards from the roof and the stalagmite which comes up from the floor.

HOW THEY FORM

The principle underlying the formation of these is interesting.

Calcium carbonate, the main constituent of limestone, is only slightly soluble in pure water—about 14 to 74 parts per million, depending on the temperature. If the water has carbon dioxide dissolved in it, calcium bicarbonate is formed. This is much more soluble to the extent of 1600 parts per million. The more carbon dioxide dissolved in the water, the more calcium carbonate will be converted to calcium bicarbonate.

If now the carbon dioxide is evaporated out of the solution, calcium carbonate will again be formed and precipitated out of the solution.

Consider now the water which has seeped through the ceiling from above. It will contain carbon dioxide from the air in addition to that dissolved in it during its passage through the soil.

Immediately a drip of carbon dioxide-charged water seeps through the limestone it will dissolve the calcium bicarbonate (converted from calcium carbonate of the limestone). As it hangs from the roof the carbon dioxide evaporates from the water and a thin film of calcium carbonate precipitates on the outside.

When the drop becomes too heavy to sustain its own weight it will fall to the floor. Some of the skin of calcite will return backwards to the base of the drop, harden and form a deposit in the form of a rim.

This rim builds up as the water supply is kept up until at a certain stage the supply is equal to the loss and the stalactite grows in thickness by accretion of material on the inside.

The stalactite grows downwards by deposits on its lower end until finally a long thin straw stalactite is formed. If the supply is not great enough the end of the stalactite becomes choked and is said to be dead. Water then flows over the outside gradually building up a deposit of calcite over the original centre.

The final shape of a stalactite depends on a number of factors among which are the impurities in the water, the speed of the water supply, the volume of the supply, the humidity of the cavern, the temperature and the wind in the cavern. For instance a constant draught on one side leads to excessive evaporation on that side with the result that a crescent-shaped stalactite is formed.

The slower the rate of growth the larger will be the stalactite.

STALAGMITE GROWTH

From the above explanation of the formation of a stalactite the formation of a stalagmite can be easily deduced. It is simply the same sort of growth upwards from the floor resulting from water falling from the roof and gradually building up a formation of calcite. Here again, the slower the rate of growth the larger will be the stalagmite.

The beautiful curtains seen hanging from the roof are caused by the water flowing downwards along the line of a crack in the rock formation.

Sometimes part of a floor is covered with a beautiful layer of calcite caused by water flowing over the surface. Almost anything of any shape can be covered in this way, its beauty being enhanced by impurities which may colour the layers according to the mineral impurity involved.

The exploration of caves by the modern speleologist is carried out by careful planning and a knowledge of cave physics with particular reference to what is termed Underground Meteorology. This is particularly concerned with the movements of air and water.

VENTILATION

Those readers who have visited our Australian cave formations know that caves are very well ventilated. This is not artificial in any way. It is rare that a badly ventilated cave is found. Most are very pleasant and some are too well ventilated by nature through passages and other openings, resulting in strong underground draughts.

It is true that the carbon dioxide given off by the water in the formation of stalactites may accumulate in pockets and blind passages but the modern speleologist knows this and avoids them.

He is also equipped with a candle or acetylene torch which gives him due warning when the concentration of carbon dioxide is too high by a diminution of brilliance or complete extinction.

In cave systems which have running water there is exceptional ventilation because air is dragged down from the surface with the water.

Study of air flow is of great value to the speleologist. For instance, if water is flowing down a passage, the flow of air can indicate whether the water flows straight through and out or whether it flows into a well. If it flows

(Continued on Page 111)

single beam ....

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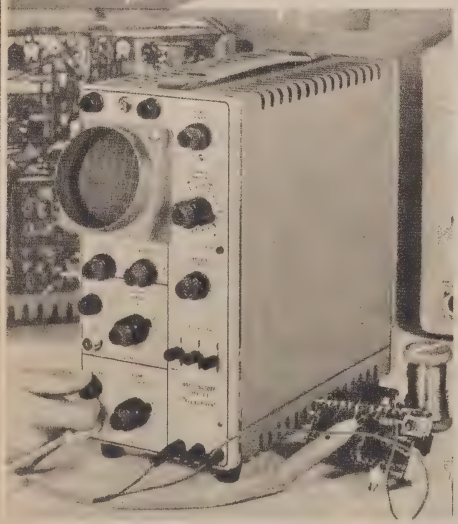

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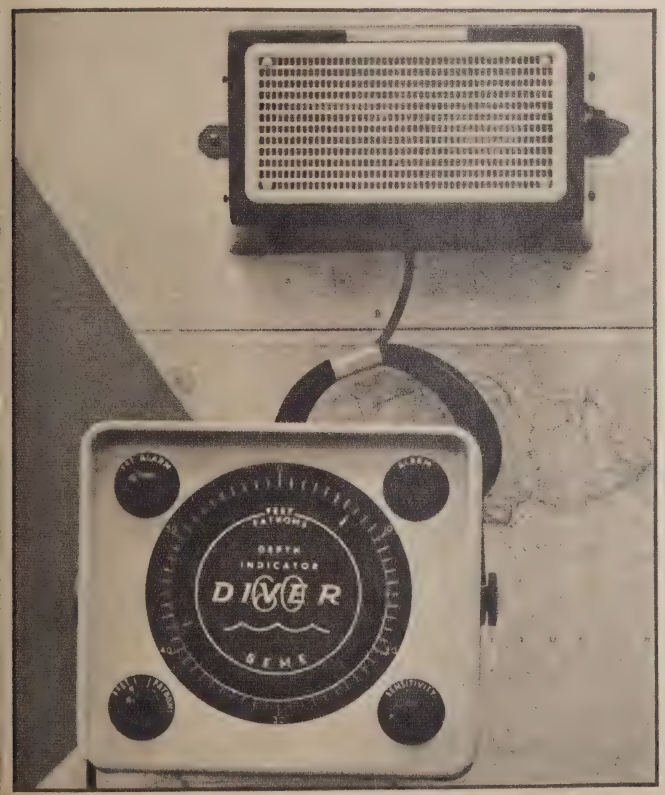
THIS is being made possible by a new revolutionary British all-transistor instrument, "Diver 60," being marketed by BEMA Telecommunications Ltd., a member of the Derritron Group, of Hythe, Hampshire.

It can be set to give a warning at any depth up to 36 fathoms. Total range of "Diver 60" is 60 fathoms.

Dimensions: 7in x 6¼in x 8¼in. **Power Supply:** 12/24 volt supply, or battery. **Material:** Non-corrosive aluminium alloy for the front panel, and cabinet, printed-circuit construction. Waterproof. Price: 45 gns. complete.

Other "small-ship" equipment available in Europe includes a 100-watt fluorescent lighting unit, a transistorised 20-watt radio telephone, an all-transistor 10-watt loudspeaker and siren and a one-unit closed-circuit TV camera, suitable for underwater service.



PLASTICS TESTED FOR CREEP

A 15-unit flexural creep test machine which can reduce materials test programs from years to months has been developed at Boeing.

TESTING 15 specimens at a time in an identical temperature environment, the Boeing - developed device shaved five years and five months—and five-sixths of the cost—off a company plastic laminate materials test program.

The program involved testing more than 1,000 specimens of epoxy resin laminate tooling materials at constant stresses from 3 to 50 per cent of breaking load and for periods of 500 hours at room temperature and at 120 degrees F.

The device, designed by Vincent Yuhas, Boeing manufacturing development engineer, is in regular use at the Boeing Developmental Centre. It consists of a six-foot rectangular metal case, enclosing 15 loading rods. One and five pound weights, placed on the rods, apply desired percentages of breaking loads to test specimens beneath the rods.

The metal case forms an enclosed temperature-controlled test chamber. A sealed, water-filled base is heated to provide temperature environments to 200 degrees F.

Deflection measurements are taken on a dial indicator which is moved along the top of the loading rods on a machined steel channel. A humidity gauge records relative humidity.

PLANS for the launching of the first British satellite — U.K. No. 1 — early this year were announced in London recently in a joint statement by the Office of the Minister for Science and the Royal Society.

The satellite, which will carry scientific instruments now being designed and made in Britain, will be launched from Wallops Island on the east coast of the United States by the American Scout Rocket.

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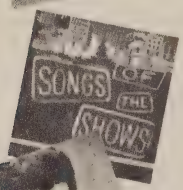

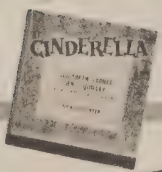

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Technical Review

"ULTRA-KAPS"—HIGHER CAPACITANCE, SMALLER SIZE

A completely new type of ceramic capacitor has recently made its appearance in American electronic equipment. The following article is based on information supplied by the Engineering Department of Centralab but similar units are likely to be released by other manufacturers in the U.S. and throughout the world.

KNOWN as Ultra-Kaps*, these patented units are made of ceramic and have the same appearance as other ceramic disc capacitors. But they are engineered on an entirely different principle.

It is important to understand this principle and be able to identify the units because **conventional testing techniques and replacement procedures do not apply to these capacitors.**

Ultra-Kaps are low-voltage capacitors used only in transistor and similar low-voltage circuits. They provide an extremely high capacitance for their size —50 to 100 times greater than that of standard ceramic units!

In other words, from the capacitance standpoint, they are in the electrolytic rather than the usual ceramic capacitor range.

A most unusual aspect of these capacitors is their self-regulating voltage characteristic. This is the major factor in accounting for the inability to use standard testing techniques.

RE-ORIENTATION

The Ultra-Kap is constructed of a material that undergoes a molecular re-orientation when an overvoltage is applied to it. This permits the current to flow through the unit, causing the capacitor to operate as a conductor rather than a capacitor.

It can be likened to an electronic valve in that the current merely flows through the unit during overvoltage conditions.

This temporary condition exists only while the higher voltage is applied. When the voltage is lowered, the unit again operates as a capacitor. Consequently, this capacitor doesn't "short-circuit" as others do when they are overloaded.

The resulting dependability of these units, as well as their exceptionally small size, accounts for their increasing application in radio, TV and hi-fi equipment.

There are approximately 7,000,000 Ultra-Kaps in use today, and there have been no known cases of electrical failure on any of them.

Based on this experience, it seems likely that any unit requiring replacement is probably a victim of physical damage rather than electrical failure.

As indicated earlier, the unusual "valve effect" of these units makes it impossible to test them in the usual fashion.

Industrially, ceramic disc capacitors are generally tested at twice rated voltage. If this test were applied to one of these new capacitors, the unit would act as though it were shorted, even if it were operating perfectly.

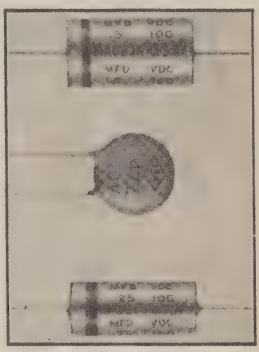
In servicing work, capacitors are usually tested for leakage resistance. However, these units have a relatively low leakage resistance which would mislead the service technician into thinking that a perfectly good unit is defective.

So it is important for the technician to know how to identify these units and how to test them.

As was mentioned previously, Ultra-Kaps are used only in low-voltage circuits. While their main application is in transistorised equipment, they are frequently used in vacuum-tube devices as cathode bypass capacitors.

They are also used in preamplifiers and crossover networks. However, they will never be found in any circuit carrying more than 10 volts.

Physically, they have the same shape and general appearance as any other ceramic disc capacitor.



An Ultra-Kap ceramic capacitor of 0.47 mfd. (centre) compared with conventional paper types of capacitance 0.25 and 0.47 mfd.

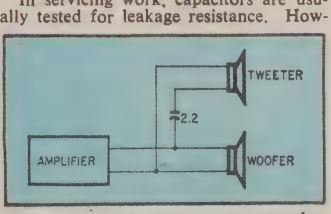


Figure 1: A crossover network application for Ultra-Kaps or similar capacitors.

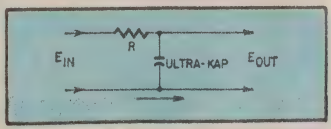


Figure 2: Suggested voltage regulator circuit using an Ultra-Kap.

ULTRA-KAP SPECIFICATIONS

CAPACITANCE VS. SIZE

Approximate Diameter (inches)	Capacitance (μf) 3 VOLTS	10 VOLTS
9/32	0.22	.05
13/32	0.47	0.1
19/32	1.0	0.2
27/32	2.2	0.47

LEAKAGE RESISTANCE 3-VOLT UNITS

Capacitance (μf)	Leakage Resistance—ohms (at 0.5 VDC)	(at 1.5 VDC)	(at 3 VDC)
0.22	500K	50K	2.5K
0.47	350K	35K	1.8K
1.0	300K	30K	1.5K
2.2	30K	7K	0.6K

LEAKAGE RESISTANCE 10-VOLT UNITS

Capacitance (μf)	Leakage Resistance—ohms (at 3 VDC)	(at 9 VDC)	(at 10 VDC)
.05	5 Meg	1 Meg	50K
0.1	5 Meg	1 Meg	50K
0.2	5 Meg	1 Meg	50K
0.47	5 Meg	1 Meg	50K

GREY-GREEN, SMALLER

However, the Durez protective coating is grey-green in colour, and they are much smaller than might be expected for a ceramic disc of such a high capacitance.

In fact, no other ceramic discs are made in this capacitance range—.05 uf to 2.2 uf. While it is theoretically possible to build high-capacitance conventional ceramic discs, they would be too large and expensive for any practical application.

The table shows the relative size and capacitance of 3- and 10-volt Ultra-Kaps and will help you to identify them.

These low-voltage capacitors can be tested with an ohmmeter, by the same

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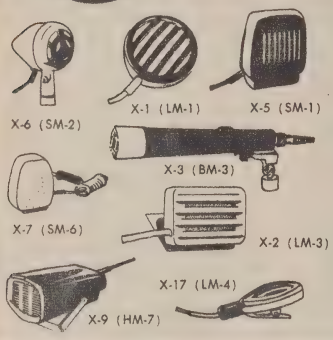
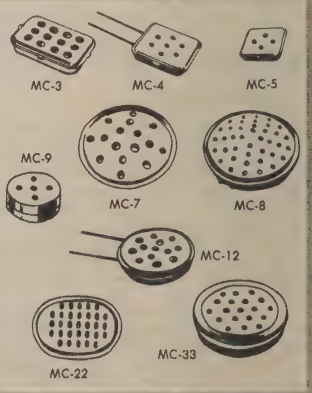


CRYSTAL MICROPHONES

Model	Type	Mounting Screw	Cartridge	Material	Cord	Dimensions Max. W.H.T.	Weight (g)
X-1 (LM-1)	Lapel	—	MC-7	Pressed brass	5 ft.	1.6" x 0.75"	46.0
X-2 (LM-3)	Lapel	—	MC-3	Urea resin mould	5 ft.	1.3" x 1.8"	60.0
X-17 (LM-4)	Lapel	—		Zinc diecast	5 ft.	1" x 2.2" x 0.81"	52.0
X-3 (BM-3)	Stand	5/8"	MC-9	Aluminium diecast	Without cord	1.3" x 8.5"	230.0
X-5 (SM-1)	Stand	5/16"	MC-8	Aluminium diecast	5 ft.		
X-6 (SM-2)	Stand	5/8"	MC-8	Aluminium diecast	5 ft.	2.2" x 3" x 3.2"	163.0
X-7 (SM-6)	Stand	5/16"	MC-8	Aluminium diecast	5 ft.		
X-8 (HM-1)	Hand	—	MC-8	Urea resin mould	5 ft.		
X-9 (HM-7)	Hand	5/16"	MC-3	Aluminium diecast	5 ft.	2.1" x 1.5" x 3.1"	119.0

CRYSTAL MICROPHONE CARTRIDGE

Model	Sensitivity (db)	Response (~)	Impedance (pf)	Material	Dia.	Dimensions D.	W.	H.	Weight (g)
MC-3	– 5 7	50 – 7,000	2,200	Pressed steel	—	1.378	1.004	0.315	7.0
MC-4	– 6 2	100 – 5,000	950	Pressed steel	—	1.126	1.126	0.213	6.0
MC-5	– 6 5	100 – 5,000	950	Pressed steel	—	0.867	0.867	0.197	4.0
MC-7	– 5 6	100 – 6,000	2,200	Aluminium	1.536	—	—	0.433	6.0
MC-8	– 5 0	50 – 8,000	2,200	Zinc diecast	1.890	—	—	0.670	31.0
MC-9	– 6 8	50 – 10,000	2,200	Zinc diecast	1.004	—	—	0.374	8.0
MC-12	– 5 5	50 – 8,000	2,200	Pressed steel	1.437	—	—	0.276	8.0
MC-22	– 5 5	50 – 9,000	2,200	Pressed steel	—	—	—	—	9.5
MC-33	– 6 0	50 – 15,000	1,000	Zinc diecast	1.24	—	—	0.26	17.0



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Model	Cartridge	Description
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asic technique that is used in testing onventional capacitors except **the capcitor must be checked on the lowest esistance scale of the meter.**

A technician usually uses the highest esistance scale or might even pay no ttention to the scale being used, since ost capacitors have an infinite leakage esistance.

This is not true of Ultra-Kaps. As the able shows, leakage resistance is relavely low and decreases rapidly with ncreasing voltage.

It is apparent from the tables that the oltage applied by the ohmmeter can ppreciably affect the leakage resistance eading. Most ohmmeters apply a test oltage of 1.5 or 3, so there would be o testing problems.

However, some meters on the market se a higher applied voltage—they cano be used to test these low-voltage nits. If you don't know what voltage our ohmmeter applies, check the batery inside the meter before you use it.

ESTING

To test a 3-volt unit, the applied voltge must be 3 volts or less. To test a 0-volt unit, the applied voltage must e 10 volts or less. Otherwise, the capcitor will appear shorted, even though it is in perfect operating condition.

While technicians generally try to relace any component with as exact an quivalent as possible, it is absolutely ssential that only exact replacements be sed when replacing these low-voltage igh-capacitance ceramics because of the ery low series inductance in them.

Equivalent paper or electrolytic capcitors have a much higher series inducance and therefore may not operate roperly in the original circuit.

A typical example of this is shown n Fig. 1. This is a simple conventional rossover network and uses a 2.2 uf Ultra-Kap. If an electrolytic capacitor were substituted for this unit, a different value might be required.

Depending upon the circuit function and its parameters, a paper or electrolytic replacement or even another ceramic capacitor, might require a capacitance from 2 to 10 times that of the Ultra-Kap.

Since there is no simple correlation factor, it is not advisable to attempt any sort of substitution when replacing an Ultra-Kap.

While this article has dealt with the testing and replacement of Ultra-Kaps, these units have a potentially wide range of new circuit applications. Although these applications have not been thoroughly investigated, it is conceivable, for example, the Ultra-Kap could be used for voltage regulation.

In Fig. 2 the Ultra-Kap in parallel with the output of the circuit would provide the basis for such a voltage-regulating device.

Since the Ultra-Kap acts also as a voltage-sensitive resistor, decreasing in resistance with an increase of applied voltage, it provides voltage-equalising characteristics at the output terminals. The Ultra-Kap could conceivably have many applications in a variety of control circuits because of this self-regulating characteristic.

However, these characteristics have not been investigated to the point where their behaviour in these circuits can be specifically stated. ("Radio-Electronics.")

PEEP—LATEST MAN-MADE MIRAGE

In the December 1960 issue we described a unique pilot display system under the heading, "Man-Made Mirage." While it may have appeared from this article that the scheme was still in the experimental stage, it is really much further advanced. A recent announcement from Great Britain advises that a version of the system known as PEEP (Pilot's Electronic Eye-level Presentation system) has successfully concluded its flight trials.

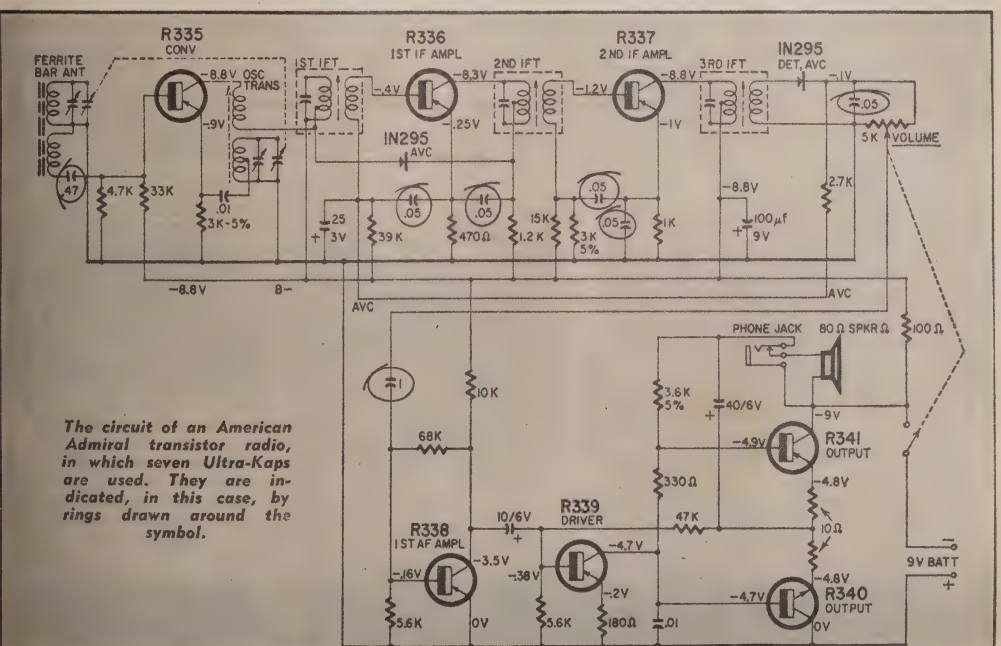
ESSENTIAL flight data is projected from a cathode-ray tube and focused at a point well ahead of the aircraft in the form of a brilliant pattern of symbols superimposed on the pilot's view of the outside world.

This enables the pilot to observe flight data while still looking ahead without the distraction of watching instruments in the cockpit.

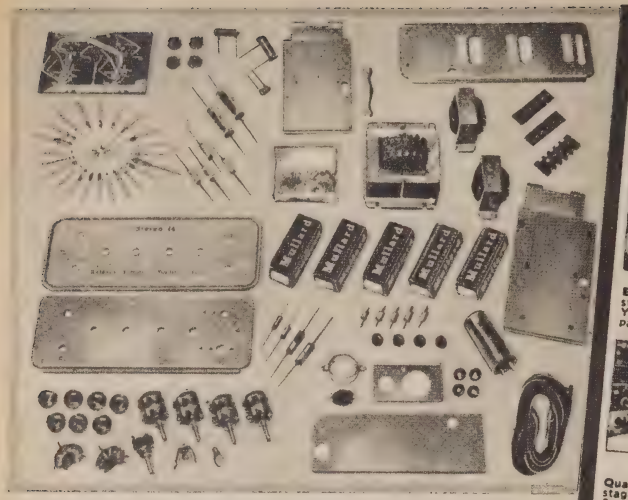
The equipment is described as an all-transistor device representing a major step forward in aircraft instrumentation.

In addition to basic information on aircraft attitude, speed, altitude and direction of flight, it is possible to display storm warning, position fixing, presence of other aircraft and similar information.

It is claimed that PEEP is of particular value in the final stages of a blind landing.



The circuit of an American Admiral transistor radio, in which seven Ultra-Kaps are used. They are indicated, in this case, by rings drawn around the symbol.



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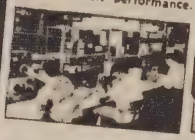

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REVIEW—MERCURY SWITCH MEASURES GAS PRESSURE

Accurate measurements of small changes in gas pressure can be made using a simple application of the mercury switch. By the addition of an electronic circuit, current through the switch can be kept to a very small figure.

IN its basic form, the apparatus consists of a U-tube containing mercury. Into one limb of the tube is fitted the end of a length of platinum wire so that it makes contact with the mercury. The other end of the wire is connected in series with a lamp in a circuit powered by a 6-volt battery.

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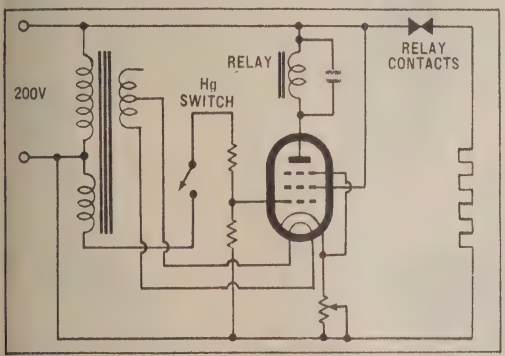
The U-tube containing mercury. At one end is the length of platinum wire forming the switch.



On the same limb a micrometer screw gauge is attached and arranged so that the screw projects into the limb of the U-tube where its point can make contact with the surface of the mercury.

To take a reading of gas pressure, the micrometer is adjusted so that it just makes contact with the mercury.

This point is easily ascertained by the fact that the lamp lights up. The reading on the micrometer scale is then noted. This is equivalent to atmospheric pressure.

The U-tube is then connected to the gas main whose pressure is required. The level of the mercury will rise or fall depending upon whether the pressure is greater or less than atmospheric.

The micrometer is again adjusted until the point just makes contact with the mercury, and the reading on the scale is again noted. The difference between the two readings then determines the gas pressure.

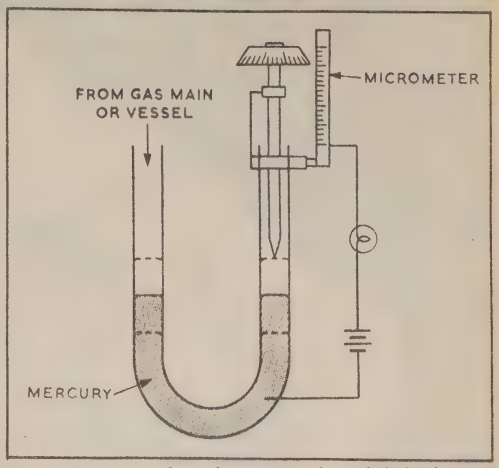
This value can be converted into conventional pressure units by applying the appropriate conversion factor.

LONG TERM ACCURACY

Such a simple device might well suffer from the disadvantage of being incapable of sustained operation. Experience has shown that accurate control over long periods is only possible when a negligible current flows through the mercury switch.

Even with a current of only a few milliamps, oxidisation of the mercury surface develops rapidly, and to be sure of an effective operation, a clean surface is essential.

The most effective method of preventing oxidisation of the mercury surface is to incorporate the switch in the control grid circuit of a thermionic valve, using a grid current limiter of one megohm or more.



☆

An amplifier can isolate the "work" from the switch, allowing current through the latter to be kept to a very small figure.

This system necessitates considerable complication of the contact device, as indicated in the diagram. The use of a relay allows aural as well as visual indication of the instant when the contact is made. ("Electronics Weekly.")

UNIQUE SPACECRAFT SHIELD

One of the problems of space exploration yet to be solved is that of protecting space craft personnel from the many forms of dangerous radiation encountered beyond the earth's atmosphere. Due to the excessive weight of conventional shielding materials, some space engineers are now experimenting with a radically different idea. What is called an "invisible radiation shield" is being developed by Boeing scientists.

THE studies being conducted at Boeing involve the use of an electrostatic field generator to repel electrons. The invisible radiation shield, a negatively charged electric field, would repel other negatively charged particles such as electrons. A spacecraft equipped with such a shielding device would be protected from electrons by "blowing" them out of its path.

Such a system could be used to protect satellites orbiting earth in the vicinity of the outer Van Allen radiation belt.

Research on radiation hazards indicates that manned and unmanned spacecraft will need a variety of shields to protect crew and equipment from radiation belts, cosmic rays and solar flares. The electrostatic field is just one of several radiation shielding studies being carried out.

Dr Donald A. Hicks, nuclear physicist who heads up a 90-man research team in the Physics Technology Department, said studies by his group have shown exotic metals also might play an important role in spacecraft shielding. Boeing physicists have been examining zirconium hydride and lithium hydride as possible shielding materials.

Radiation hazard becomes a particular problem in space flight because the ship loses the protection of the earth's own natural radiation shield—the atmosphere.

Two heavy bands of radiation, called the Van Allen belts, girdle the earth. Beyond them are the so-called "galactic cosmic rays" and the solar flares, intermittent bursts of radiant energy from the surface of the sun.

Boeing studies indicate the spaceship's structures, fuel, water and food supply offer the most promising shielding material at this point in the planning. Dense metals such as lead make efficient shields but increase the weight of the ship so greatly the usable payload is severely limited.

("Boeing News Bureau.")

STILL

the finest loud-speaker in Australia

Model 12UX Hi-Fi

Laboratory measurements and listening tests continue to prove the Model 12UX the outstanding loud-speaker in the current Rola range — still the finest loudspeaker in the Commonwealth. This statement holds true irrespective of price, for the 12UX will outperform loudspeakers costing nearly twice as much. Any loudspeaker intended for high fidelity applications must possess good Transient Response, a smooth Frequency Response, adequate Power Handling Capacity and low Intermodulation Distortion. The Rola Model 12UX has all these features — and in good measure.

Its large magnetic unit employs the latest high energy magnet material and has been designed to provide the utmost efficiency. This in turn results in first class Transient Response, an essential feature if "clean", crisp reproduction is to be obtained.

The Frequency Response of Model 12UX meets the most stringent requirements of the most critical listener and is within ± 6db. between 40 cycles per second and 14 kilocycles per second. Its triple cone construction provides smooth mechanical cross-over and avoids the phase displacements and consequent distortions encountered in multiple loudspeaker combinations.

Finally, its Peak Power Rating of 30 watts at an extremely low level of Intermodulation Distortion means that under normal operating levels this distortion will be too low to be detected by the most critical ear. These are the reasons why the Rola Model 12UX is still the finest loudspeaker in Australia.

ROLA COMPANY (AUST.) PTY. LTD.

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CALTEX HOUSE, KENT STREET, SYDNEY, N.S.W. — BU 6147
ROLA COMPANY (N.Z.) LTD., RISHWORTH STREET, WINGATE, NEW ZEALAND — 67211

RET/60

SCIENTIFIC & INDUSTRIAL NEWS

LARGEST NUCLEAR STATION

THE 800-megawatt-capacity nuclear power station planned by the Central Electricity Generating Board for Anglesey, in North Wales, will be the largest in the world equipped with nuclear reactors rather than conventional furnaces; its electrical production capacity will be 200 megawatts above that of any station in Britain, the largest to date being now under construction at Sizewell, in Sussex.

When it comes into production in 1967, it is expected that the Anglesey station will be the first to be built at a cost of less than £90 per kw of installed capacity, compared with the £160 per kw cost of the Berkeley, Gloucestershire, station. It is also expected to be the last of the Calder Hall type of reactors.

UNUSUAL ALLOY

THE research laboratory of a major chemical company has announced discovery of a manganese alloy which, unlike most other magnetic materials, loses its magnetism as its temperature falls.

The alloy is chromium manganese antimonide, a brittle grey material. The exact temperature where it becomes magnetic can be varied over a range of several hundred degrees by small changes in its chemical composition. It is reported to be non-magnetic at room temperature.

Apparently this characteristic is due to the distance between atoms in the alloy. When they are close together, they are aligned in a non-magnetic pattern. When the material expands with heat, the atoms move further apart. This permits them to move into a magnetic pattern.

E. I. Du Pont Co., Wilmington 98, Delaware, U.S.A.

MAGNETIC ALLOYS

MAGNETIC alloys which hold their characteristics up to 1,100 degrees Fahrenheit are now available but research indicates that the surrounding conditions may be as important as the alloy itself in withstanding temperature effects.

Typical is a cobalt-iron alloy. Tests at 1,100 degrees Fahrenheit have indicated severe corrosion in the unprotected magnetic material but, tested in an inert atmosphere, the magnetism remained stable.

Westinghouse Materials Research Laboratory, 3 Gateway Center, Pittsburgh 30, Pennsylvania, U.S.A.

FOIL PIPES

LIGHTWEIGHT aluminium pipe, produced by winding foil on a mandrel with an adhesive between layers, is now available in the United States. Pipe built up of layers of foil each .0035 to .0005 inch thick is reported to be 30 per cent lighter than solid pipe of a similar size.

The first licensee of the new process will use it to produce heating ducts. However, the originating company says the same system can be used to build up odd structural shapes by laying the foil and adhesive over a form and stripping it off when bonded.

By using a combination of foils, shapes of any desired strength, chemical properties and corrosion resistance can be obtained.

Foil Process Corporation, Van Nuys, California, U.S.A.

PLASTER BRICKS

A NEW type of plaster brick made from material which has been aerated by a special process has been developed in Australia.

The bricks are said to be exceptionally strong, light in weight and virtually fireproof. They are also said to have excellent sound-insulation properties, with the thermal insulation qualities such that a 3½-inch brick will give the same thermal insulation as a 26-inch-thick solid conventional brick wall.

They are larger in size than conventional bricks, but can be laid twice as fast as conventional bricks.

The raw material used for the manufacture is gypsum. This is mixed with chemicals, which produce an aeration reaction when the raw materials are poured into fibreglass moulds.

Ultimate Building Materials Ltd., 70 Hawker Street, Brompton Park, Adelaide, South Australia.

IRIDIUM PLATING

USE of iridium deposited electrolytically is now being recommended for protecting small parts where the cost is not prohibitive.

At high temperatures iridium is inert, hard, and has a melting point above 4,000 degrees Fahrenheit.

Iridium plating in the past has used a molten salt technique. The new plating process, using a water-based electrolyte, is reported to be much simpler.

Plating current is about 20 amperes per square foot and electrolyte temperature around 100 degress Fahrenheit.

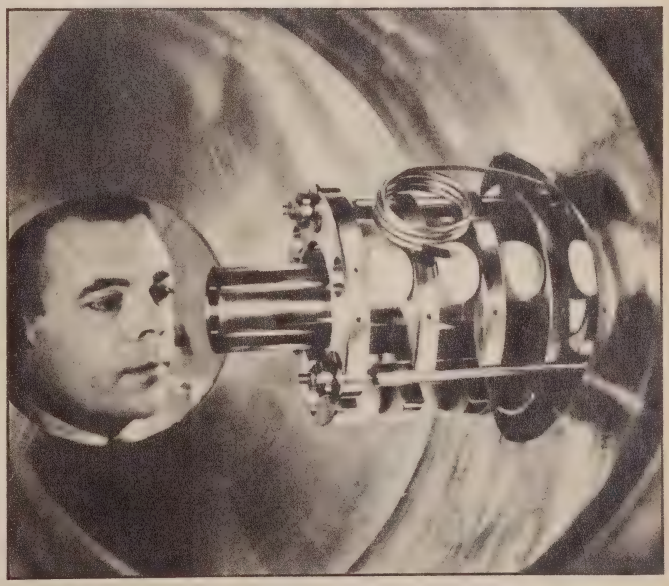
E. L. MacNamara, Frankford Arsenal, Philadelphia, Pennsylvania, U.S.A.

X-RAY EXPLORATION

THE research laboratories of a big oil company are using a new X-ray and computer procedure to "fingerprint" rock specimens and speed the discovery of oil.

Newly devised analytical equipment, which operates unattended, employs an

100,000 mph FROM ION ENGINE



Vacuum created in this armoured chamber almost simulates the condition of space in testing an ion engine developed by Goodrich-High Voltage Aeronautics Inc., as a means of propelling interplanetary vehicles at speeds beyond 100,000 miles per hour. Physicist Bill Beggs checks the "business end" of the unit which operates by firing a beam of electrically charged particles. The model was shown for the first time at the recent American Rocket Society meeting.

IRC SERVICE TO INDUSTRY SERIES

MANAGEMENT

"WE STANDARDISE ON IRC"

IRC AUSTRALIA

With competition becoming more and more active, quality with low cost is an absolute essential. We certainly can't fault IRC quality standards—they more than meet the very rigid qualifications we lay down.

But, most important, the economy of buying from a large-scale producer like IRC is obvious when we make comparisons. IRC research, too, keeps us well ahead.

That's why we standardise on IRC components.

IRC AUSTRALIA

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Sole Australian Agents: WM. J. McLELLAN & CO. PTY. LTD., 126 SUSSEX STREET, SYDNEY. BX 1131

Victoria: AUSTRALASIAN ENGINEERING EQUIPMENT CO. PTY. LTD., 202 BELL STREET, PRESTON. 44-6532, 44-5431, 44-1305

(SUBSIDIARY COMPANIES OF INTERNATIONAL RESISTANCE HOLDINGS LTD.)

msa1021c

X-ray machine and a computer which 'memorizes" the characteristics of 35 commonly observed minerals.

The computer, through an elaborate mathematical program, absorbs and digests the punched card data for a set of unknown samples, identifies the constituent minerals, calculates their approximate percentage occurrence and correlates and prints a complete analysis of the important minerals contained in the rock samples.

Normally a staff of trained analysts could determine the mineral composition of only a few core fragments a day. With the new equipment a detailed analysis of rock samples at the rate of 150 or so per day is said to be possible, nearly 50 times faster than previous methods.

Gulf Oil Corporation, Harmarville Research Laboratories, Pittsburgh, Pennysylvania, U.S.A.

NEW RESIN

A NEW type of resin is said to combine exceptional electrical and thermal insulating properties with high strength and good resistance to humidity.

The material, based on the use of polyester-type resin compound, keeps its electrical insulating properties at a constant level at up to 130 Centigrades. As a result, when used for the manufacture of capacitor film, the finished product outlasts that made from old types of polyester resins by eight to one.

At the same time, the compound has very good resistance to acids and a large number of other chemical compounds.

Uses for the material are expected to range from electrical and electronic engineering and packaging for the food and pharmaceutical industries to atomic energy and mechanical engineering.

Eastman Chemical Products Inc., Kingsport, Tennessee, U.S.A.

TEMPERATURE MEASUREMENT

A NEW series of transducers, or information transmission devices, enables surface temperature measurements to be carried out over a regular operating range of from absolute zero up to 2,000 degrees Fahrenheit.

The operation of the units depends on a system based on a specially developed platinum wire enclosed in a capsule of pure aluminium oxide, Their accuracy and speed of operation is said to be exceptionally good.

Arthur C. Ruge Associates Inc., Hudson, New Hampshire, U.S.A.

NOVEL PAIN KILLER

A NEW type of anaesthetic mouthwash has been developed to relieve pain in the mouth and throat within a matter of seconds.

Tests carried out with 105 patients have shown that in the case of all but three patients pain was relieved in five to 10 seconds following or during dental operations. Moreover, the relief from pain which was experienced is said to have lasted for several hours.

Although the clinical tests of the new compound have so far been limited to cases in dental surgery, it is expected that the anaesthetic action of the compounds should prove useful, if not equally effective, for the treatment of local abrasions.

Developed by a New York dental surgeon. Further details are not available at the present time.

SMALL ENGINES

PETROL engines small enough to power hand drills are now available to United States tool builders. They are already offered with aircompressors, electric generators and pumps.

The basic engine was developed by a company which formerly specialised in engines for model aircraft. It will fit in a 6-inch cube.

The single cylinder, air-cooled engine has a swept volume of 1.26 cubic inches —21 c.c.—and produces about .7 horsepower at 6,300 revolutions per minute. Its weight is 3.25 pounds and it can be run in any position.

Ohlsson and Rice, Los Angeles, California, U.S.A.

LIGHTWEIGHT ENGINE

A PETROL engine whose cylinders and block construction are brazed up from stainless steel sheet will soon be available as a lightweight power plant for sports cars and boats.

There are two major innovations in the engine. One is that the usual removable cylinder head assembly is absent. The other is the use of .1-inch thick stainless steel instead of cast metal for the block assembly.

The water jacket is in the shape of a flat-bottomed V. The open end of the cylinder is placed on the flat of the V, and pipes for the valves are fitted to holes in the closed end of the cylinder. The whole assembly is then brazed with copper.

The maker says the thin metal used improves cooling and avoids hot spots. The new engine will run at 12:1 compression ratio.

Tyce Engineering Corporation, 809, G. St., Chula Vista, California, U.S.A.

ONE-WAY P.E. CELL

A PHOTO-ELECTRIC cell unit that will operate only when the light beam is interupted in one direction is now being produced.

Should an object pass through the beam in the reverse direction nothing will happen. Only one photocel housing is used to achieve this result and no relays are involved.

The system can be used to monitor moving webs of any material including —it is stated—paper, polythene, rubber and steel, and indicates by an audible or visible alarm any break or tear.

Hird-Brown, 244 Marsland Road, Sale, Cheshire, England.

STEEL FOR TOOLS

AN air-hardening tool steel said to have minute, uniformly distributed sulphide alloy particles, is claimed to have good machining qualities. At the same time, the maker says, these particles provide self-lubrication when the steel is used as a die. The steel hardens at between 1750 and 1775 degrees Fahrenheit to a Rockwell C. point of 63 to 65.

Darwin and Milner, 2222, Lakeside Avenue, Cleveland 14, Ohio, U.S.A.

Just Landed

PIEZO

Crystal Stick Microphone Type BM3

Solid metal cast case with swivel mounting to fit any standard stand. Frequency response from 50 to 10kc.

Only 50/-

plus postage

Special Desk Stand To Match

Only 19/11 plus postage

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To fit most crystal Microphones. Super priced at only 15/ each.

Type MC7. Diameter 1⅝in (Replacement for SM6, etc.). Frequency Response 100 to 6kc.

Type MC9. Diameter only 1in. (Replacement for BM3). Frequency Response 50 to 10 kc.

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PRICE'S RADIO

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'Phone BL3146

Our new sweep generator, housed in a standard small instrument case. An etched panel will be available in due course to give a professional finish to the completed instrument.

New Sweep Generator For TV Alignment

The sweep generator described in the following article provides output on both the sound and vision IF channels and is a relatively simple and inexpensive instrument for alignment of television receivers. It is a logical development from the simple instrument described last year and, in addition to the extra band, offers other improvements which make it even simpler to operate.

By Alan Nutt

IN the May, 1960, issue, we described the construction and operation of a 36Mc sweep generator suitable for video IF alignment and incorporating a commercially available sweep unit. The company that supplied the original unit, Prodis Electronic Instruments of Adelaide, have now made available a two band sweep unit covering the sound IF channel of 5.5Mcs in addition to the video IF channel.

NEW UNIT

We felt that it would be well worthwhile describing a completely new sweep generator, constructed around this particular unit, and presenting an instrument well within the reach of the serviceman or home constructor.

An examination of the circuit will show that there is little difference between this and the earlier model of the generator, the main points being the addition of a second tuned circuit in the oscillator section for 5.5Mc operation, the inclusion of a phasing control and an improved deviation control. The original deviation control potentiometer has been replaced by a rotary switch which adjusts the amount of deviation, or frequency swing, in predetermined steps.

These last two improvements may be easily fitted to the original design, with some advantage, even if there is no thought of adding the 5.5Mc band.

The sweep unit itself, as supplied, is complete with all the oscillator components, except the valve, assembled on a small aluminium bracket for sub-mounting in a chassis containing the power supply and the remaining components.

For the benefit of those who may not have read the original article, a few words are in order concerning the operation of the unit.

The heart of the generator is a normal push-pull connected oscillator. However, in order to cover a particular range of frequencies either side of the resonant frequency of the oscillator, some means has to be provided for varying one of the frequency determining elements in the oscillator circuit, and varying it at some definite rate.

In this case, the frequency is made to vary by changing the permeability of the ferrite core on which the tuning coil of the oscillator is wound. This change in permeability is effected by applying a 50 cycle sinusoidal voltage to a control coil sharing the same magnetic circuit as the tuning coil. The same voltage also is applied to the CRO as the horizontal sweep voltage.

DC BIAS

Some form of DC bias is necessary on the control coil, otherwise the application of any voltage, either positive or negative, would cause a reduction in permeability and hence the permeability would change from a maximum to a minimum every half cycle, or 100 times a second. By applying a suitable DC bias voltage, the AC control voltage will either add or subtract from it and so cause a maximum to minimum swing of 50 cycles per second. This ensures that the sweep voltage will be logically related to the CRO time base.

The DC bias voltage is fed to the control coil through a potentiometer. Adjusting this control will have an effect on the centre, or rest frequency of the oscillator as it, too, will cause a shift in the permeability of the magnetic circuit. Thus it provides an effective "fine tune" control.

In order to suppress the retrace image and provide a reference base line on the CRO screen, a blocking voltage is applied to the oscillator that prevents oscillation every half cycle. So that the right phase relationship might be maintained between the oscillator sweep frequency and the CRO horizontal sweep voltage, a 90 degree phase shift is necessary between the CRO voltage and the oscillator blocking voltage. The 56K resistor and .1 mfd capacitor are used to provide this phase shift.

PHASE RELATIONSHIP

Similarly, correct phase relationship must be maintained between the CRO sweep voltage and the current through the control coil. Unless these two are exactly in phase, the display will be nonlinear and, in extreme cases, suffer fold-over effect at the end of the trace. Due to the inductance of the control coil, there will be a phase shift between the voltage applied and the current through the coil, making further phase correction necessary.

This correction is provided by a second phase shift network, the .33 mfd capacitor and 50K pot in the sweep voltage line to the control coil. Since the

xact phase relationship will vary slightly according to a number of factors, including possible phase shift in the CRO orizontal amplifier, the 50K pot is used o provide the final adjustment.

The most accurate way to make this djustment is to compare the forward nd return traces as presented when here is no retrace suppression. When hese coincide as closely as possible the hase relationship is correct. To facilitate this adjustment, we have provided he necessary controls on the front anel, operated by a single knob.

This was made possible by combining a pull-on, push-off type switch with he 50K phasing pot., the switch portion eing used to short circuit the retrace uppression voltage at the junction of he phase shift components and 1N1763 iode.

In operation, the control knob is pulled out and then rotated until the forward and return traces are co-incident. It is then pushed in to restore the blocking voltage and the reference base line on the CRO pattern.

SPECIAL POT.

(We incorporated the switch on the potentiometer in order to save space on the front panel and the need for an extra component. An ordinary pot and separate switch may be used, however, with no difficulty apart from locating a suitable mounting position. The phasing adjustment should be checked when changing from one band to the other or when making any large change in the fine tuning control.)

Fig. 1 shows the effect of incorrect phase adjustment on the CRO. Adjusting the phasing control will cause the two patterns to merge together until they coincide almost exactly. (Fig. 2.)

The padding resistor in series with the Fine Tune potentiometer has been reduced to 10K in order to place the centre frequency more towards the middle of the range covered by the potentiometer, particularly on 5.5Mcs.

The resistance values indicated on the

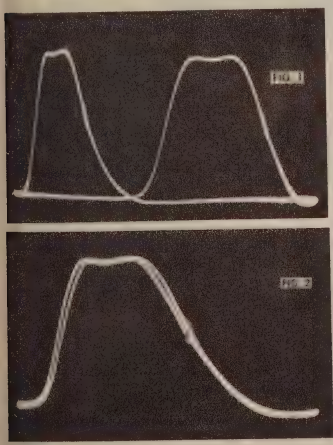
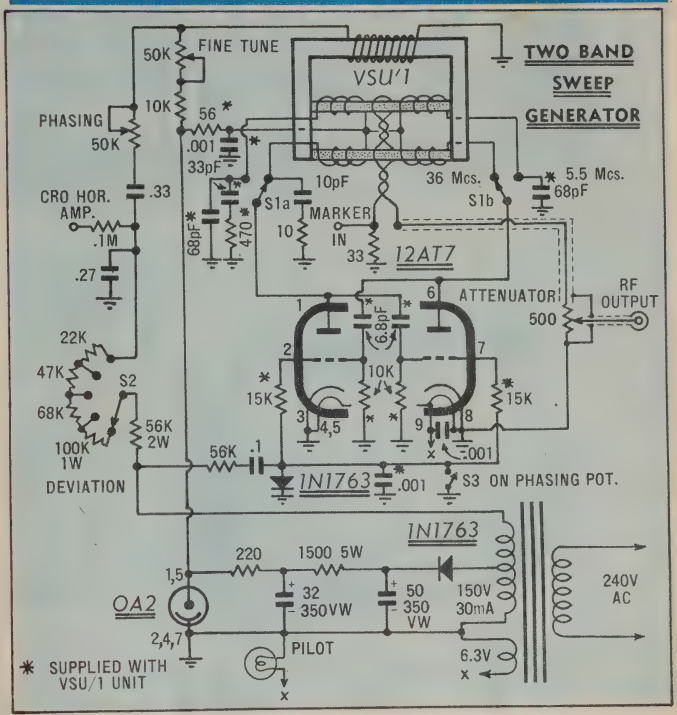


Fig. 1 shows a video IF response curve with oscillator blocking removed. A marked phase shift is apparent between the forward and retrace patterns. Fig. 2 shows the same trace with the forward and retrace patterns correctly phased as discussed in the text.

GENERATOR COVERS 36 & 5.5 Mc



The circuit diagram differs little from the original sweep unit, the main changes being the provision of a band switch and additional coil for 5.5Mc operation.

deviation control switch proved satisfactory in our own particular case, the reduction in sweep width being more or less constant with each switch position. Should it be necessary to alter the deviation for one reason or another, there is no reason why an adjustment could not be made to either the 56K series resistor or to the value of the resistors on the switch itself.

Too much deviation, of course, will compress the pattern to the point where it becomes useless.

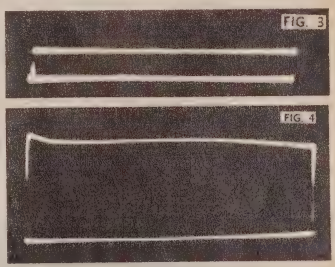
CONSTRUCTION

As far as the actual construction is concerned, it follows closely the pattern of the original generator. However, the new sweep unit, as mentioned before, is already constructed as a sub-assembly and is mounted in a square cut out of one corner of the chassis. All the wiring from the unit is terminated on a tag strip mounted down one edge and suitably coded for easy identification.

All the power supply components as well as the 90 degree phase shift components associated with the retrace blanking are mounted on two tag strips at the other end of the chassis. The resistors on the deviation control are mounted directly on the switch wafer.

We should mention again the need for single-point earthing in conjunction with the RF output socket and attenuator control. Unless this precaution is taken, there is the possibility of RF leakage from the instrument which can cause severe pattern distortion on the CRO.

The RF output socket must be insulated from the panel and the earth return made via the shielded braid on the cable back to the earthing point



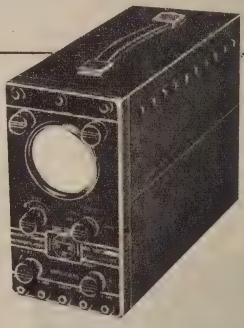
The output response curve at 5.5-Mc (Fig. 3) is almost perfectly flat while the response at 36Mc (Fig. 4) is well within accepted limits. These traces were obtained using a demodulator probe.

on the sweep unit itself, as indicated in the circuit diagram. No braid earth connection should be made to the case of the attenuator potentiometer, the earthy side of the control being returned to the common point as well.

The marker input earth terminal should also be insulated from the chassis

TV TEST INSTRUMENTS by University Graham

Electronic Volt Ohmmeter (V.T.V.M.) Model TVR-EV. This smartly styled electronic Volt Ohmmeter is suitable for TV and radio servicing and employs a large 8-inch illuminated meter. It will measure negative D.C. voltage, positive D.C. voltage and A.C. voltage in steps of 1, 3, 10, 30, 100, 300 and 1,000 self-contained. Peak-to-peak A.C. voltages may be extended to 30,000 volts by use of the external probe resistance up to 1,000 megohms and the D.C. voltages can be extended to 30,000 volts by use of the external probe Model TV30. Crystal probe and valve probe enable RF voltages up to 1,000 to be checked, and the wide frequency response makes it entirely suitable for TV servicing and other application.



Oscilloscope 3-inch, Model TVR/C3
Small and portable, this Cathode Ray Oscilloscope is invaluable for TV and radio service work as well as industrial use. Although compact in size, it contains the features of larger instruments, is flexible in use and offers many new features. It is suitable for the visual alignment of TV receivers, and direct access is possible to both horizontal and vertical plates for examination of strong voltages. It can be supplied with a demodulator probe for signal tracing work in TV chassis. Vertical amplifier response plus or minus 1 db from 15 cycles to 150 kC/s and 6 db down at 1 megacycle.

TV Servicemen!... and Service Organisations

You are invited to inspect our television and radio test equipment under working conditions at our factory, 5 North York Street, Sydney, in a special demonstration room. We are situated in one of the arches under the Harbour Bridge, with easy parking facilities.

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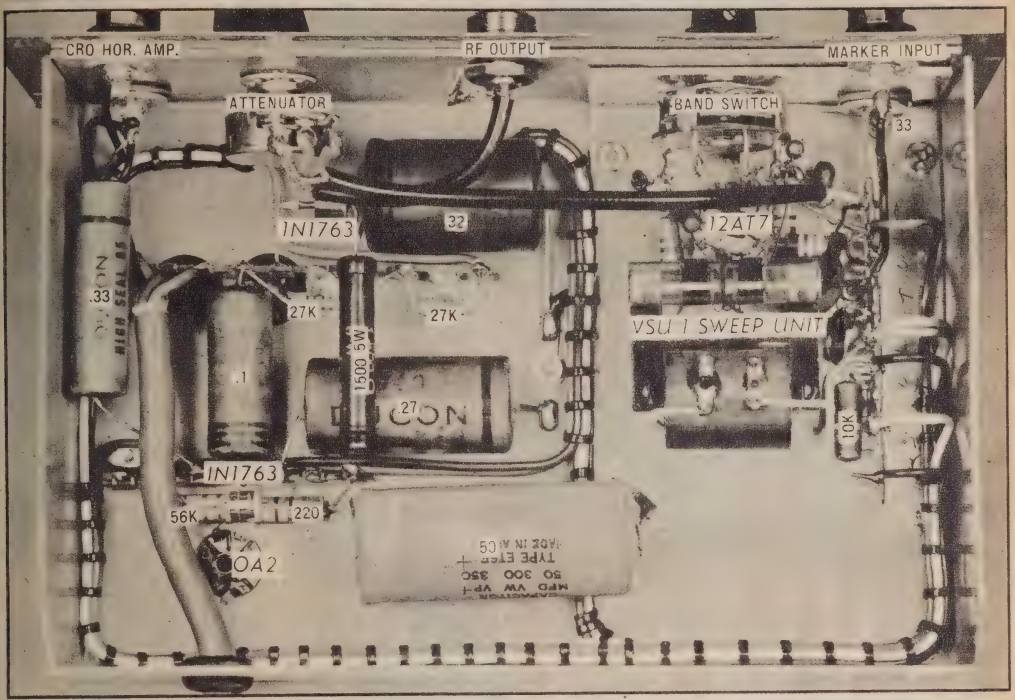
UNDERCHASSIS LAYOUT IS NEAT AND SIMPLE



The under chassis photo shows component layout. The 100K isolating resistor was added in the CRO Hor. Amp. lead after the photo was taken and was mounted on a two terminal tag at the rear of the RF attenuator.

and the earth return made to the common point.

One component worthy of comment is the 500 ohm carbon pot specified for the attenuator.

After the original article was published, we received a number of queries concerning the availability of this item, which appeared to be unduly scarce.

Recent enquiries have revealed that a carbon pot of this value is a standard item with at least two manufacturers in Sydney and there should be no difficulty in obtaining them through the normal trade channels. This applies, in addition, to the phasing control pot and switch, which is also a standard line.

DAMPING NETWORK

On testing the generator in our laboratory, we felt that the output on 36Mc could be made a little more constant in amplitude. It can be appreciated that any variation in output voltage over the swept range will give rise to distortion in the response curve as displayed on the oscilloscope.

In order to overcome this, a damping network is normally inserted from the plate of one section of the 12AT7 to ground. In the original unit this network consisted of a 33pf capacitor and a 470 ohm resistor in series and was common to both bands.

In order to improve the response at 36Mcs, we removed the original damping components from the plate of the valve and connected them to the other side of the band switch so that they were effective only on 5.5Mcs. We then proceeded to try various values and combinations that would give a constant amplitude output on 36Mcs and finally arrived at the value of 10 ohms and 10pf. These were connected in series from the other bandswitch contact to chassis and are effective only on the 36Mc range.

It may be, however, that such procedure is not warranted in every case or, if it is, that these values will not be optimum. It would appear best to leave the original damping components in position until after the instrument is completed and tested. Then, if the output is not

PARTS LIST

1 Case, 9in x 6¾in x 5½in.
1 Chassis, 8in x 5½in x 2¼in.
1 Panel, 9in x 6¾in.
1 Power transformer, 150 volts a side at 30mA, 6.3V at 2A.
1 VSU/1 Sweep oscillator unit complete.
1 5 position rotary switch.
1 Shielded single contact microphone socket.
4 Terminals. (2 red, 2 black).
1 7 pin miniature socket.
1 9 pin noval socket.
2 1N1763 silicon diodes.
1 12AT7.
1 OA2.
1 Pilot lamp assembly.
4 Pointer knobs.
1 Small round knob.

CAPACITORS.

1 50 mfd 350VW electrolytic.
1 32 mfd 350VW electrolytic.
1 .33 mfd 400V paper.
1 .27 mfd 400V paper.
1 .1 mfd 600V paper.
1 10pf ceramic.

RESISTORS.

(All ½W unless otherwise specified)
1 100K.
1 100K 1W.
1 68K.
1 56K 2W (2 27K 1W in series.)
1 56K 1W.
1 47K.
1 22K.
1 10K 1W.
1 1500 5W WW.
1 220 1W.
1 33 ohm.
1 10 ohm.
1 50K 2W potentiometer.
1 50K pot. with push-pull on/off switch. (Ducon).
1 500 ohm carbon potentiometer.

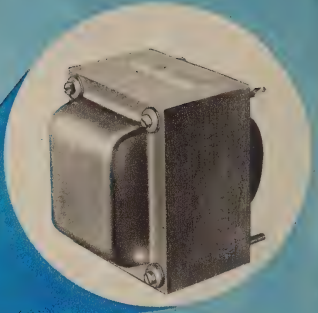
SUNDRIES.

2 3 lug tag strips.
2 8 lug tag strips.
Nuts, bolts, hook-up wire, PT9M coax, power flex and plug.

National

7-WATT STEREO TRANSFORMER KIT

Front view of
Unit Amplifier No. 2



POWER TRANSFORMER F150/104VD
Prim. 230, 240, 250 V. A.C., 50 cycles
Sec. 104, 114, 124 V. A.C.
250 V. D.C. at 150 mA
Fil. 6.3 V. at 5.0 A
Dimensions. Height 3¾"
Width 3⅛"
Depth 3¾"

DESIGNED FOR UNIT PLAYMASTER No. 2

The Unit Playmaster No. 2 was designed by "Radio, Television and Hobbies" and featured in the August, 1960, issue. NATIONAL have designed these components specifically for the Unit Playmaster, and the kit is available from all electrical wholesalers. If further details are required, write immediately to NATIONAL.

AUDIO TRANSFORMER FCD 9,000/15UL
Freq. response 10c/s-40Kc/s ± 3db
Prim. Imped. 9,000 ohms P.P.
Screen tap 20% of Plate Imped. 45% of turns
Sec. Imped. 2, 3.75, 15 ohms
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Watts—Rating 15 W.
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Current: 150mA
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afficiently level, suitable values can be determined experimentally.

The output response is checked by means of a demodulator probe of the type described in the September, 1960, issue for use in conjunction with the 3in CRO. The probe may be connected directly to the vertical amplifier input terminals of a CRO and the sinusoidal sweep from the generator feed into the horizontal amplifier. The results should approximate those shown in Figs. 3 and

A marker generator is absolutely essential when using the sweep generator, otherwise the shape of the CRO pattern is quite meaningless. An ordinary signal generator which will cover the sweep ranges, either on fundamental or harmonics, is all that is required.

CABLE TERMINATION

For video IF alignment, the sweep generator is connected into the tuner mixer stage. In order to facilitate this, we cut an ordinary 9-pin valve shield across the middle and then rejoined the two halves with four 300 ohm resistors. The can was then placed over the mixer valve and the generator connected between the top of the can and chassis. The four 300 ohm resistors provide approximately 70 ohms terminating impedance for the cable from the generator.

It is not wise to use the generator without terminating the output lead, preferably with a non-conductive resistance equal to the characteristic impedance of the cable from the generator. Failure to do this will result in standing waves being set up on the cable with the possibility of stray RF radiation causing a distorted pattern on the CRO.

The internal time base in the CRO should be turned off or disconnected and the sinusoidal sweep voltage from the generator connected to the horizontal amplifier input. The trace length may then be adjusted by means of the horizontal gain control on the CRO.

It is essential that some form of fixed bias be applied to the IF stages during alignment. There is not normally enough AGC bias voltage developed by the sweep signal and a fixed voltage of around four volts, taken from a potentiometer connected across a battery, is usually required.

VIDEO ALIGNMENT

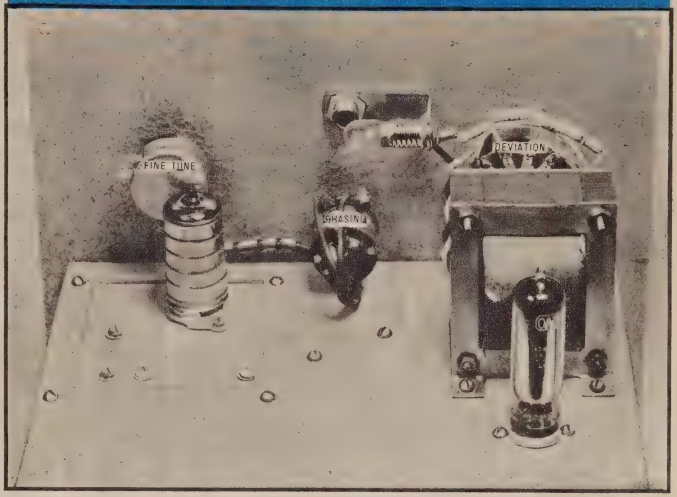
The vertical input to the CRO is connected to the plate of the video amplifier, via a 50K isolating resistor. Some form of pattern should be visible on the screen and this may be centred by means of the fine tuning control. The marker signal may then be fed in (keeping the level low), the response of the curve checked, and the IF transformers adjusted until the required shape is obtained.

The sweep generator output should be kept as low as possible, consistent with a good, readable trace pattern. If the output level is too high, one or more of the IF stages may be overloaded with the consequent distortion of the pattern. A typical pattern, obtained from this generator, is shown in figure 5.

The alignment of the sound IF channel and discriminator circuit requires the sweep generator to be connected to the grid of the video amplifier.

Disconnect the electrolytic capacitor between the detector diodes and connect the CRO to the output of either diode.

LAYOUT OF MAJOR COMPONENTS

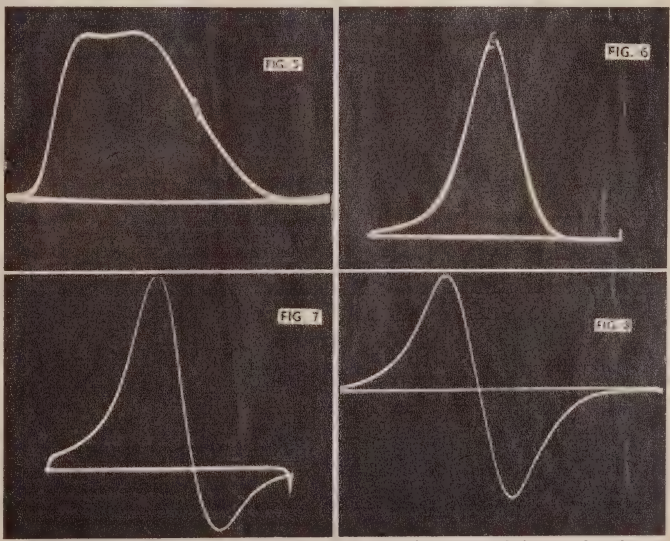


The chassis cut-out for the sweep unit sub-assembly can be seen in this rear view. It is important that an aluminium chassis be used to prevent magnetic fields from the power transformer affecting the operation of the sweep oscillator.

It is best to select the diode that gives an upright pattern on the screen, the other diode connection resulting in an inverted pattern. A small capacitor (around .01 mfd) should be connected across the vertical amplifier input terminals to filter any RF present at the detector output.

Adjust the sweep generator attenuator so that a suitable trace is visible on the screen, taking care not to feed in too much signal which will result in overload and distortion.

An accurate 5.5 Mc marker signal should now be fed into the sweep generator and the sound trap (if part of the IF system) and first IF aligned so that the marker pip will occur at the peak of the signal trace. (Fig. 6). The dis-



These response curves are typical of what can be expected during the alignment of a TV receiver. Fig. 5 is a video IF response curve showing a 36Mc marker pip. Fig. 6 shows the response of the sound IF channel with a marker placed at 5.5Mc. Before alignment of the discriminator transformer is undertaken, the response curve will appear as in Fig. 7, the curve being assymetrical about the centre reference line. Correctly aligned, the discriminator response curve should be perfectly symmetrical as indicated in Fig. 8. A marker signal should be used as indicated in the text to check that the crossover point on the trace is exactly 5.5Mc.

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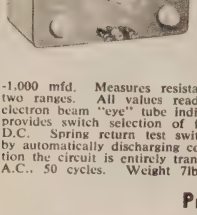

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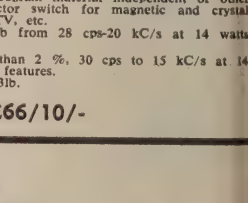

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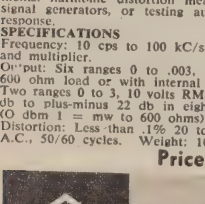

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criminator primary core should be adjusted for maximum amplitude in which condition the symmetry of the curve should be approximately as indicated in Fig. 6.

Shifting the CRO connection to the audio output point of the detector circuit should produce the characteristic 'S' curve and the discriminator secondary core should be adjusted for absolute symmetry either side of the centre reference line. If it is not possible to obtain symmetry, the phasing adjustment should be checked and also a test made to determine if the trace crosses the reference line at exactly 5.5 Mc.

MARKER PROBLEM

The marker pip will not be visible at this point and another method must be resorted to in order to determine the exact centre frequency. Assuming that a standard signal generator is being used as the marker generator, apply normal modulation and tune through 5.5 Mc. It will be noticed that the beat pattern will indicate zero at the centre frequency, becoming more complex either side of the point of crossover. The frequency at which zero baet occurs is the crossover point and may be read directly from the marker generator dial.

Should this check indicate that something other than 5.5 Mc as being the centre frequency, then the marker frequency has been incorrectly set and should be rechecked and the alignment carried out again. It will be found that the setting of the discriminator secondary slug is usually quite sharp when obtaining optimum balance.

It will be noticed that the base line tends to wander up and down the pattern as the marker generator is tuned across the band. This effect is caused by loss of the DC component through the vertical amplifier in the CRO and can only be eliminated entirely by using a DC vertical amplifier. Removing the electrolytic bypass from between the detector diodes reduces the shift considerably, however. Do not neglect to replace it after alignment is completed.

It is best that the marker signal be removed when checking the symmetry of the "S" curve although it is usually found that the base line crosses the sweep trace at its centre when the marker frequency is exactly 5.5 Mc, the line only tending to move up and down as the marker frequency is shifted either side of 5.5 Mc.

SYMMETRY CHECK

Assuming the pattern appears symmetrical, a check with the marker generator should show the peaks of the curve to be equally spaced from the centre frequency. In our particular case the peaks were 100 Kc either side of centre but this value will depend on the discriminator transformer design.

Operation of the generator is by no means limited to its fundamental frequencies. It is possible to use the harmonics, particularly of the 36 Mc range, to carry out alignment of the front end of a TV receiver. The second harmonic will provide quite a good signal in the Channel 2 region while the fifth and sixth harmonics may be used on Channels 7 and 9 with a slight adjustment of the Fine Tune control on the generator. Output on the sixth harmonic is necessarily weak but nevertheless, still usable.

It must be remembered that the deviation will be proportional to the harmonic used so that for the higher bands it may be necessary to reduce the fundamental deviation considerably in order to prevent more than one harmonic being visible on the CRO at the one time.

Another method that may be employed where harmonics do not fall in the required band, or harmonic output is limited, is to use the sweep generator in conjunction with a standard signal generator. Feeding both generators into a crystal diode will allow mixing to take place and provide output at either the sum or difference frequencies of the two generators. (Fig. 9.)

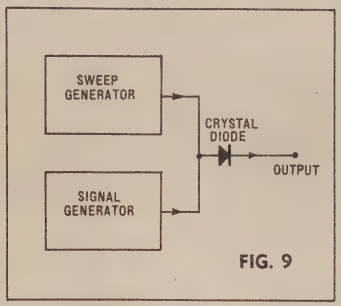

FIG. 9

Where frequencies are required other than those available from a sweep generator, the set-up shown here will enable these to be obtained by beating the sweep generator output with that of a conventional generator.

At the lower end of the spectrum, usable sweep voltages may also be obtained by the mixing method mentioned. We carried out some tests on a normal 455 Kc IF channel as well as in the broadcast band and found the resulting trace very satisfactory. We did find, however, that the provision of marker pips at these lower frequencies was a problem. The marker signal beat extends almost the entire width of the trace and, in some cases, even beyond. It is quite difficult to determine just where the centre of the pip is meant to be.

A number of methods are available for marker insertion at the lower frequencies but are rather more complex than is warranted in a simple instrument of this type.

Even so, the low frequency response curves that can be obtained are still very useful for observing symmetry and they may also be used for visual alignment purposes.

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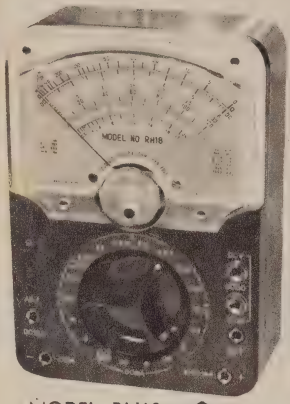

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As a further step in our discussion of electronic measuring instruments, this month we are discussing the Cathode Ray Oscilloscope. The operation of the cathode ray tube is used as a basis for the discussion, allowing the final instrument to be shown as a logical development from the tube itself.

By Jamieson Rowe

THE CRO or Cathode Ray Oscilloscope is perhaps the cause of most concern to beginners in electronics, because of the most peculiar patterns which appear upon its screen. Also of concern is the bewildering array of knobs and dials on the instrument, giving it a most formidable appearance.

It usually comes as somewhat of a shock, therefore, to learn that the CRO is basically a quite simple instrument.

The whole operation of the CRO depends upon one vital part, the cathode-ray tube. We must therefore commence our discussion of the CRO with the operation of such a tube.

As we saw earlier in this series of articles, an electron placed in an electric field is acted upon by a force, causing it to be moved in a certain direction. As we defined the electric field, we discovered that an electron is forced to move in exactly the opposite direction to that of the field. This is because an electron is a unit negative charge, while the electric field is understood as the direction of the force upon a unit positive charge.

We also found that an electric field is set up in the space between two bodies having unequal charge, and thus having a potential difference between them. These two principles are the basis of the cathode ray tube, as we shall now see.

Figure 1 is a diagram of a common cathode ray tube. In the tube a heater, which has been omitted for the sake of clarity, raises the temperature of the cathode K, encouraging thermionic emission of electrons. Surrounding the cathode is an element G, called the control grid. Although this element looks quite different from the control grid of a normal valve, it does a very similar job.

As the diagram shows, the grid has a small hole opposite the surface of the cathode. Electrons can only reach the remainder of the tube via this small hole, which affords a control of the number of electrons passing through it. The control is exercised by making the grid more or less negative with respect to the cathode, exactly as in other valves.

If the grid is made strongly negative with respect to the cathode, the number of electrons passing through the hole is very small due to the repulsion experienced between the electrons and the negative grid. If the grid is only slightly negative, however, a greater number of electrons pass through. The negative voltage on the grid thus enables the number of electrons reaching the rest of the tube to be controlled.

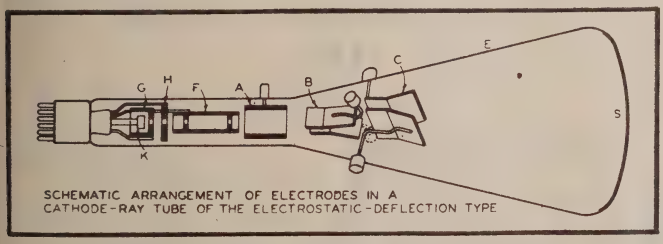

Figure 1: Typical C.R. tube as used in oscilloscopes.

As we shall see later, this controls the brightness of the final pattern.

The electrons emerging from the hole in the control grid are speeded up due to the influence of an accelerating electrode, H. This is placed at a considerable positive potential with respect to the cathode (and thus the electrons). Its positive potential attracts and accelerates the electrons, most of which pass through the hole in its centre, which is in line with the hole in the grid.

They then pass through a cylindrical electrode F, known as the focusing anode, before being accelerated further by the influence of the final accelerating anode A.

FOCUSING ACTION

Electrode F is called the focusing anode because it forms the electron beam into a compact, converging stream. The beam of electrons is thus very small in cross-sectional area when it finally reaches the screen S. The actual focusing action is carried out by curved electric fields between the focusing anode and the two accelerating anodes H and A.

Focusing thus may be controlled by varying the voltage on the focusing anode, which naturally alters the two fields.

So far, all the tube electrodes have been to produce the electrons and form them into a compact beam, directing them towards the screen. This part of the tube is thus called the "electron gun."

From the electron gun, the electrons pass between two sets of parallel plates, B and C, called the deflection plates. These plates are at an average potential equal to that of the final acceleration anode, but there may be potential differences between the plates of each pair.

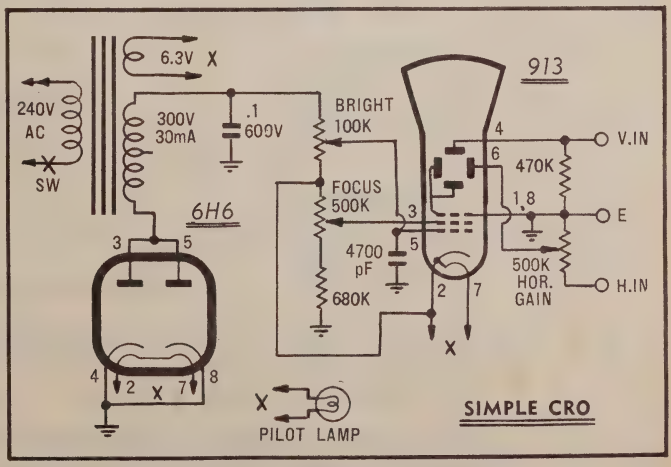

Figure 2: An elementary oscilloscope.

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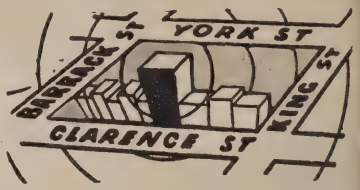

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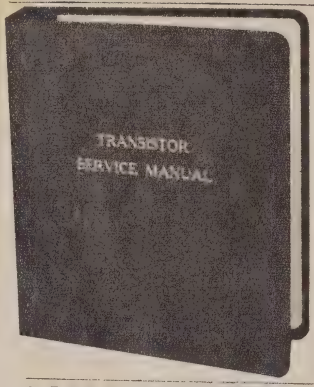

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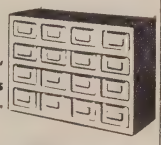

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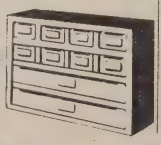

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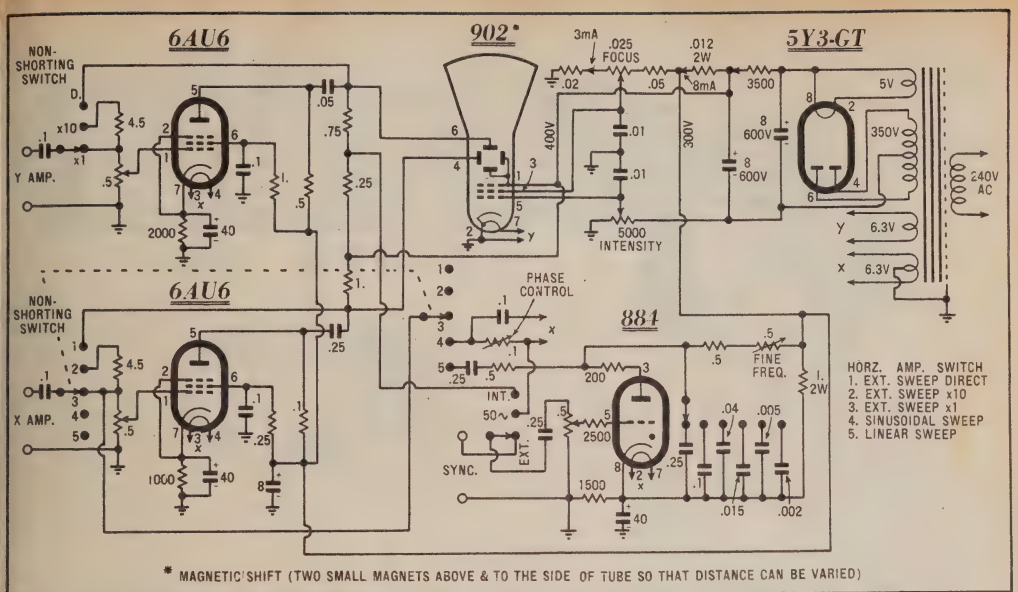

Figure 3: A somewhat more advanced (though still simple) oscilloscope, containing an inbuilt timebase and an amplifier for the signals to be observed.

It is the potential differences between the deflection plates which cause the beam to be displaced from its central position. If, for instance, one of the B plates is positive with respect to the other, there will be an electric field between the two, and the electron beam will be deflected in the direction of the more positive plate.

If an alternating voltage is applied between the two plates, the beam will be swung alternately towards each plate, and will oscillate to and fro. The end of the beam thus traces out a motion proportional to the applied voltage on the screen.

To make this of any use, we must make it visible, since electrons themselves are invisible. To make the position of the beam visible, the screen is coated with a compound of metallic salts, which have the property of glowing or "fluorescing" when impinged upon by electrons.

VOLTAGE "VIEWER"

The cathode-ray tube thus affords us a means of viewing a voltage by making the position of a glowing spot on the screen proportional to the voltage, which is applied between the two deflecting plates.

If there is no voltage between the two plates, the spot on the screen will be in the centre, and stationary. If there is a direct or steady potential between the plates, the spot will be at a position other than the centre, but still stationary. And finally, if there is an alternating potential applied, the spot will oscillate up and down with the alternations, appearing as a line if the frequency of the applied voltage is sufficiently high to involve persistence of vision or the time constant of the glowing powder of the screen.

Obviously, this can be used to measure applied voltage by noting the magnitude of the deflection produced. However, we often wish to know more about voltages encountered in electronics. The waveform, for example, is of particular interest in the case of time-varying voltages.

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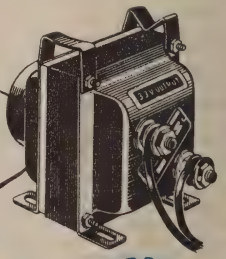

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axis (usually the vertical one), and the reference quantity, such as time in the case of a normal time-varying voltage, in the other (horizontal) plane.

By fitting the cathode-ray tube with a second set of plates (C in the diagram), which are capable of deflecting the beam in a direction at right-angles to that of the other set, we can use the tube to show the waveform in the conventional manner. All we have to do is supply the second set with a voltage proportional to the reference quantity, such as time in the case above.

Figure 2 shows the circuit for a simple CRO using a 913 cathode ray tube. As you can see, it is mainly a power supply to provide the tube with the necessary operating voltages.

POWER SUPPLY

The transformer and rectifier (the 6H6) produce an output of about 400 volts DC, which is polarised so that positive is earthed. Thus the top of the 100K potentiometer marked "brightness" is at minus 400 volts with respect to earth. The brightness pot and the two lower resistors form a voltage divider across this voltage.

Thus the most negative electrode of the tube is the control grid, pin 5 in this case. The potentiometer allows the grid to be varied in potential with respect to the cathode, which is connected to the bottom of the brightness pot. This varies the number of electrons finally reaching the screen, and thus the brightness.

The second resistor in the divider chain is also a potentiometer, which has the focusing anode (pin 3) connected to the moving arm. This allows the voltage on the focusing anode to be adjusted to the value required for correct focus, which is probably about 100 volts with respect to the cathode.

The final accelerating anode is tied to earth, and is thus the most positive electrode of the electron gun. The complete deflection system is also tied to earth, and is thus at the same average potential as the final anode.

In fact, one of each set of deflection plates is actually connected to the final anode inside the tube itself. This merely means that one side of each deflection circuit is tied to earth, a point of little consequence here.

DEFLECTION

The deflecting plate used to deflect the beam in a vertical direction (in conjunction with its mate) is the one connected to pin 4 in this case. As can be seen from the circuit, the test voltage is fed straight from the vertical input terminal to the plate. The plate is also returned to earth through a high resistance to peg it at earth potential under zero signal conditions.

A similar connection is used for the plate used for horizontal deflection, connected to pin 6. In this case, however, the pegging resistor is made a pot, which is used as a voltage divider to control the amplitude of the horizontal signal.

You will notice that the control grid is tied to earth with a small capacitor. This is to prevent any hum present in the output from the power supply from reaching the grid. If any hum were present, it would cause the beam to vary in intensity with the hum signal, and cause inconvenience.

Obviously, this circuit is rather limited in its application, for it is only an indicating device. Both the test signal and the reference signal have to be supplied, and both must be of sufficient amplitude to deflect the beam by a visible amount. This requires voltages of the order of tens of volts, which is rather inconvenient in many cases.

Figure 3 shows the circuit of an instrument having rather greater versatility. As before, we have the cathode-ray tube itself and its power supply. In addition, we have three extra valves and associated circuitry.

Two of the valves, the two 6AU6's, are used as voltage amplification stages to enable small voltages to be observed on the screen. A small voltage is thus amplified to a degree determined by the gain controls, and is then applied to the tube plates as before. This overcomes one of the limitations of the elementary oscilloscope shown in figure 2.

The third valve, an 884, is used in a circuit which generates a signal used as a time-reference. It is, therefore, called the "timebase" generator, and generates a voltage having a waveform similar to a ripsaw tooth profile.

To serve as a reliable reference signal with respect to time, the signal from the timebase must move the cathode ray tube spot horizontally in a linear fashion with respect to time. The only way for this to occur is for the potential between the two horizontal deflection plates to linearly increase with time.

NOT INDEFINITELY

Obviously, this cannot happen indefinitely, for the spot would soon pass off the side of the screen. However, since most signals of interest repeat themselves in a periodic manner, this is not necessary. All we need to do is to allow the spot to fly quickly back to its original position, and repeat its time-linear motion. Then the successive cycles of the test signal will be superimposed upon each other on the screen.

Thus the signal from the timebase must be in the form of a sawtooth wave —slowly rising linearly with time, then falling quickly to zero for the retrace of the spot.

The timebase circuit shown, which is one of the simplest types, generates a signal which is reasonably close to this ideal to satisfy many practical uses. It does this because of the characteristics of the 884 valve used in the circuit.

The 884 valve belongs to the class of valves known as "soft" or "gas-filled" valves, also known as THYRATRONS (the dot in the valve symbol signifies this). These valves have the property of almost zero plate resistance when conducting. They also have the property of being uncontrollable by the grid when they are in the conducting condition.

SAWTOOTH WAVE

Thus a thyratron with plate voltage applied and with a negative grid voltage greater than a critical figure will not conduct. If the grid voltage is reduced to the critical figure, however, the valve will "fire" or conduct, and the grid thereafter loses all control. The only way the valve will cease to conduct is upon the removal of the plate supply.

The circuit shown uses the thyratron properties in the following manner. A capacitor (one of the set selectable by the switch) is allowed to charge from the HT line via a variable resistance (the 0.5 meg and the 0.5 meg pot.). It does so in an approximately linear

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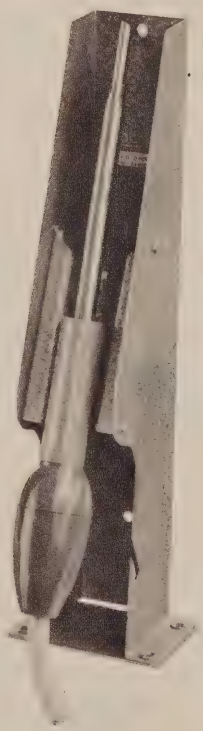

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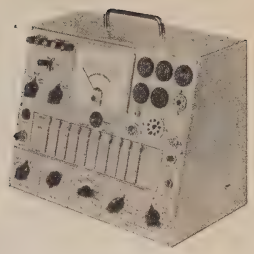

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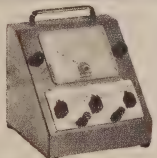

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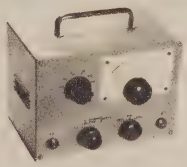

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fashion, and the voltage across it (th output voltage) rises reasonably linear with time (it really rises exponentially but if the thyratron limits the rise t the first part of the exponential, it practically linear).

When the capacitor voltage reache the firing plate voltage of the thyratro (which is connected directly across it the thyratron fires, and effectively shor the capacitor to earth. The capacito voltage thus falls sharply, providing th fast drop in deflecting voltage for th spot retrace across the screen.

When the capacitor voltage falls t zero, the thyratron immediately cease to conduct and again appears as an ope circuit. The capacitor then recommence charging, and the process repeats itsel indefinitely.

The capacitor used for charging ca be varied, as also can the resisto through which it charges. This allow the scanning rate of the spot to be varie to match the repetition rate of the wave form under observation. A signal ca also be fed to the grid of the thyratro to synchronise the sweep and test signals by triggering the exact firing instan from the vertical signal.

Well, Tom, this has been perforce rather sketchy description of the cathode ray oscilloscope. However, it shoul have shown that the instrument is no nearly as formidable as it appears a first glance. Basically, it is the cathode ray tube set up to allow easy observa tion of electrical signals. All the rest o the instrument is used for extending th versatility of the observing device.

CHANNEL TUNNEL

(Continued from Page 5)

also been proposed that a fuel gas line should be laid from the natural gas fields in the Sahara to supply the gas boards in England.

If this comes about the gas line could also be laid in the pilot tunnel.

The trains using this tunnel would probably be of Continental gauge, which is rather broader than the English one. Also, the coaches would be of Continental design. This would mean that the tunnel trains would be suitable for all of Europe.

LINE TO LONDON

A new line would have to be laid from the tunnel to London, as the larger trains would not fit the existing stations in England.

However, this would not be a disadvantage, as it would mean that faster train times could be expected and there would be no delays due to other services.

How much then would this tunnel cost? The latest estimates are that about £109,000,000 would have been spent before it was completed, and that the income from tolls would amount to about £13,000,000 per year.

It is suggested that the toll for each person using the tunnel would be 32/ and for a car £4. There is no doubt that, when the tunnel is completed, traffic across the Channel will increase and it may be that it will show a bigger profit than that estimated.

It is, therefore, to be hoped that the time when work starts will not be far distant.

For Beginners:—

No changes are necessary to the outward appearance of the set, which is still housed in its neat plastic case.

A Two-Transistor Broadcast Receiver

Last month we described how to make a simple, one stage transistor set, with the emphasis on simple construction for the beginner. And, having made such a set, most experimenters will want to go a little further. So, here is the story of how to add a second transistor and provide additional amplification.

By John Davidson

THE simple one stage set, if correctly built and adjusted, is capable of really surprising performance, particularly when we remember how few components it requires.

In most places in the metropolitan area it should be possible to receive many local stations without even worrying about an external aerial and earth, while the addition of the latter will permit satisfactory operation in much less favourable localities.

SOMETHING LARGER

And, having achieved this much, the reader will logically begin to think in terms of something a little bigger and capable of significantly better performance. Is it possible, for example, to add another stage to this simple set, and will the improvement be worthwhile?

The answer to both parts of this question is yes. Another stage can be added, and it will provide a worthwhile improvement. Even if we employ it in quite a simple circuit, it will still provide a useful amount of gain, and this can be beneficial in a number of ways.

In the first place, if weak stations dictate the need for an aerial and earth with the single stage version, it may well be that the extra stage will make this unnecessary. It is not necessary to emphasise the convenience which this provides, no matter where the set is used.

Secondly, there is the question of headphones. Unfortunately the most convenient — and economical — versions, such as the personal earpieces, are not always the most efficient. Thus, whether we can enjoy the advantages of these units depends to a large extent on whether we have enough signal available to drive them adequately.

Another point concerns ease of operation. Though not quite so important, it is true that any attempt to receive weak signals with a single stage calls for very careful adjustment of the regeneration control, and this can be a nuisance. While it still is necessary to adjust this control correctly for best results, the provision of a little extra gain means that many stations may now be received without the need for ultra-critical adjustment.

In order to bring you up to date, let us briefly revise what we said last month about the operation of the single transistor stage. As we mentioned then, the transistor performs three functions; detection, audio amplification, and RF amplification for the purpose of regeneration.

As with a valve in a similar circuit, two of the three elements — in this case the emitter and base — are used as a diode to provide detection, current flowing more readily in one direction than the other.

This current flow between the emitter and base regions will have a marked effect on the current flow between emitter and collector, producing a current amplification in the collector circuit. This is the second function.

REGENERATION CIRCUIT

The third function is to amplify the RF signal which appears at the aerial, and feed it back to the input, producing regeneration. This will increase the selectivity and sensitivity by a very high order.

To enable us to add a second stage, the collector circuit, via the regeneration winding, is connected through a 6,800 ohm load resistor in place of the headphones. From this point on the circuit operates as a conventional transistor audio amplifier. Common emitter configuration is used as on previous occasions, this arrangement providing a high power gain with adequate frequency response.

The most obvious method of coupling is that of resistance-capacity, due to its simplicity. The interstage coupling capacitor is required to have a low reactance compared with the series impedance of the previous stage, at the lowest frequency it is desired to amplify. A low voltage type electrolytic capacitor of 5 mfd is used in the circuit.

The statement made last month concerning the RF transistor bias network could also apply to this stage but we will take this opportunity to elaborate on the subject a little.

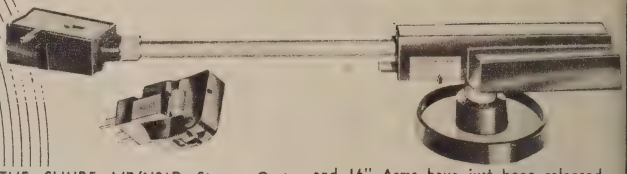
The base is connected to the junction of two resistors which form a voltage divider network across the battery supply. Due to the polarity of the battery the base-emitter junction is biased to conduct and said to be "forward biased." This condition requires the base to be a fraction of a volt negative with respect to the emitter. A much greater negative voltage is applied to the collector electrode to produce the reversed bias condition required for the base collector junction.

PROTECTIVE RESISTOR

The 2,200 ohms resistor between the emitter circuit and earth is fundamentally a protective device to guard against "thermal runaway." Functioning in much the same manner as the cathode bias resistor in a valve circuit, it develops a voltage whic his dependent on collector current.

If the collector current is increased due to temperature rise, the voltage drop across this emitter resistor also will increase, making the emitter electrode

world acclaimed **SHURE**



THE SHURE M7/N21D Stereo Cartridge is simply the world's best, and has thus been "check rated" by independent reports above all others. Compliance is 9 x 10-6 cm./dyne, and playing weight must NEVER exceed 2½ grams maximum, but can be less. Reproduction is of very wide range, yet completely free from "over brightness." Shure 12" and 16" Arms have just been released, being fully adjustable for all cartridges, and completely balanced in all directions. For the economy-conscious music-lover who wants a high quality stereo cartridge at moderate cost, there are also new stocks of the famous Shure Custom M7/N7D which maintains all the benefits of the Shure Dynetic design at a popular price.

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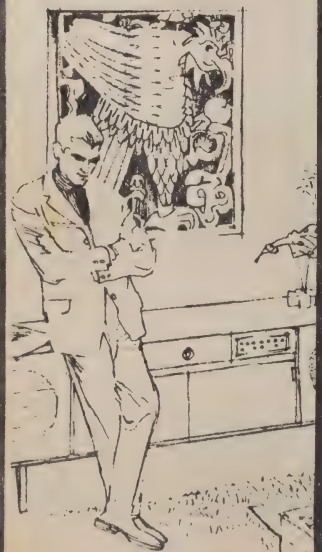
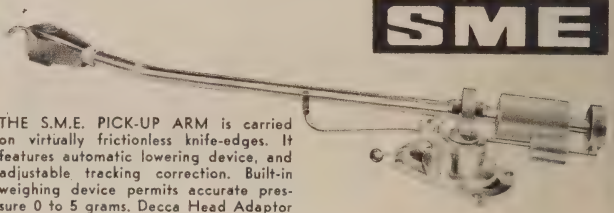


SME



THE S.M.E. PICK-UP ARM is carried on virtually frictionless knife-edges. It features automatic lowering device, and adjustable tracking correction. Built-in weighing device permits accurate pressure 0 to 5 grams. Decca Head Adaptor available.

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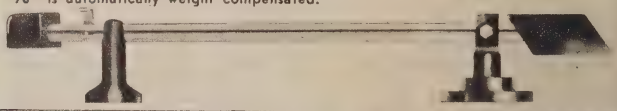
THE DECCA, recognised as Britain's finest integrated Pick-up, can now be supplied with up to three separate plug-in heads for every type of recording. Stereo and L.P. track at 3.5 grams. The "78" is automatically weight compensated.



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THE "ALL BALANCE" Pick-up Arm is reasonably priced, yet features the static balancing principle, usually associated with expensive equipment.

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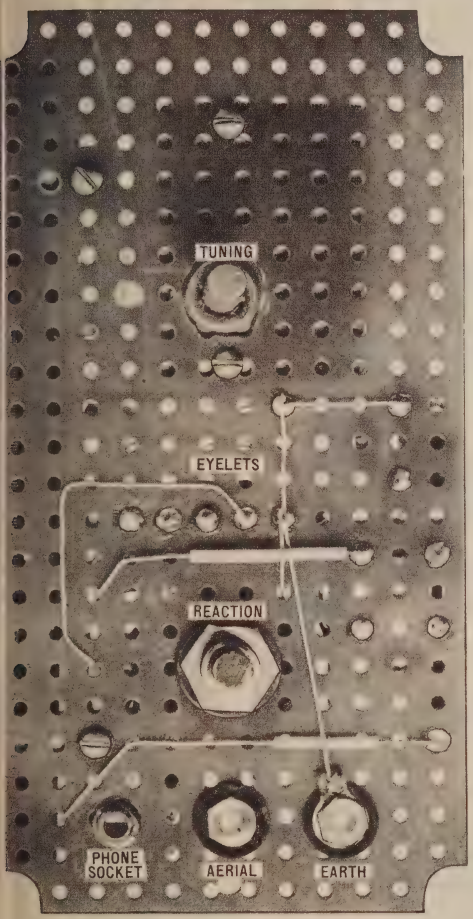
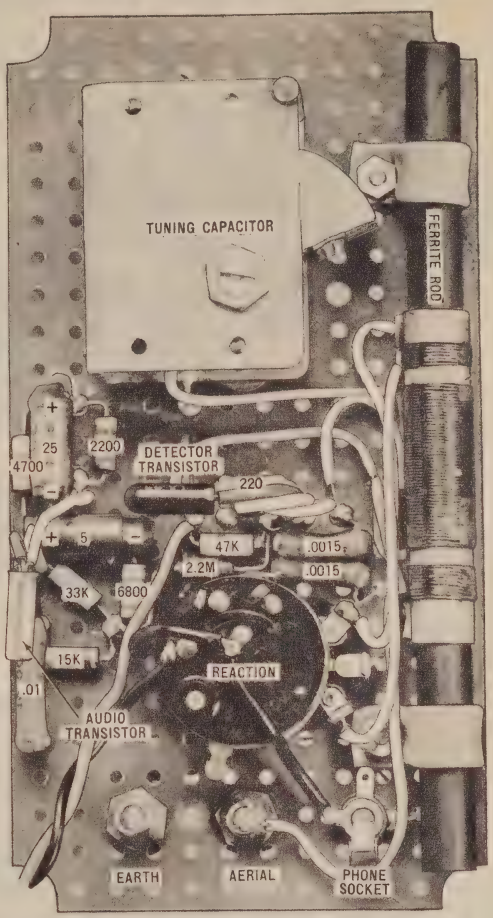
ASSEMBLY AND WIRING—FULL SIZE PICTURES





The placement of the few extra components is shown clearly on these two full size pictures. Most are accommodated to the left of the potentiometer in the right hand picture.

re negative and approaching the ential of the base electrode. This nge will reduce the bias on the tran- sor, and decrease the collector cur- nt. Thus "bias stabilisation" is ieved.

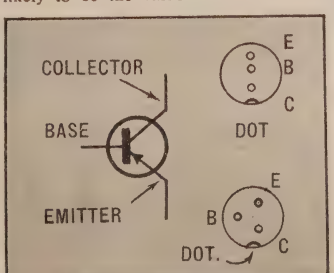
The parallel 25 mfd capacitor is large ough to provide a suitable bypass at lowest audio frequency, avoiding un- e negative feedback.

As shown in the main circuit the col- tor load is provided by a 15 K resis- across which is connected the crystal piece in series with a suitable coup- g capacitor.

This earpiece is included in the main cuit because we feel that, with the ra gain available and considering its v cost, it probably is the most attrac- e proposition.

There are two other supplementary cuits showing the connection of the dio stage for two other types of head- ones.

The first shows the arrangement when using high impedance phones. Although these are commonly referred to as 4,000 ohm impedance types this figure is more likely to be the value of the DC resistance, the impedance being nearer the 10,000 or 20,000 ohm mark depending upon the construction. The circuit still maintains the bias stabilisation components, due to the high impedance collector circuit.



Any of the transistors specified will use one of the base arrangements shown in this diagram.

The second circuit shows the most suitable arrangement when using the lower impedance phones having an impedance of a few hundred ohms. This is the type most frequently available from disposals dealers for a low cost. In this circuit we recommend a simple bias method consisting of a .1 megohm resistor between the negative terminal of the supply and the base electrode.

The current drain of the receiver is very small: wired for either the high impedance phones or the crystal earpiece the set draws approximately .5 mA overall. If wired for low impedance phones the current drain will be a little over 1 mA.

All the resistors may be of the half

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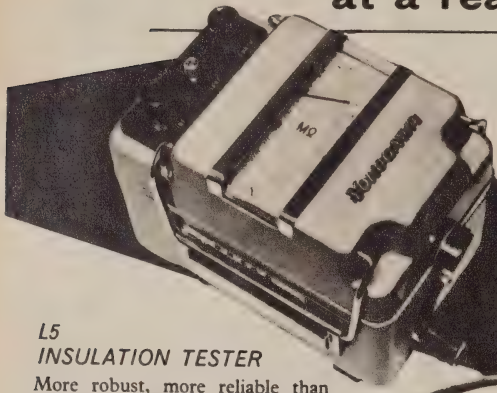

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OA-17

watt type, which are quite adequate and have the advantage of lower cost and small physical size, both important factors in a project like this. However, if larger types happen to be on hand there would be no objection to using them provided they can be accommodated in the space available.

It also is likely that alternative transistors may be on hand, and any of the following types may be used without any circuit alterations: OC70, OC71, TS1, TS2, TS3, OC65, OC66.

Now we come to the constructional details of the extra stage. It was mentioned last month that space was allowed on the lower portion of the matrix strip for the provision of a second stage and reference to the coded photographs on page 47 will show clearly how this has been done.

MATRIX BOARDS

The photograph of the matrix strip, looking from the front, is on the left of the page and shows the layout of the extra eyelets and tinned copper wire strapping. Seven eyelets have been added to the original set and these can be seen nearest the right hand edge of this photograph.

Looking at the right hand photograph and comparing it with that of last month, the position of each extra component can be clearly identified. The eyelet directly to the left of the regeneration control provides a new distribution point for the negative battery supply via the potentiometer switch. The 2.2 megohm forward bias resistor used in last month's circuit has been re-positioned and anchored to this eyelet.

The second eyelet directly above this (partly obscured by the 5 mfd capacitor) anchors the 6,800 ohm collector resistor and 5 mfd coupling capacitor. The length of tinned copper wire previously connecting the upper terminal of the reaction control to the phone jack, is removed from the latter point and run directly across to this second eyelet.

The third eyelet, to the left of this, anchors the positive end of the coupling capacitor, the base of the transistor and the junction of the two voltage dividing resistors. One of these, the 33K, can be seen in a diagonal position, connecting to the negative battery distribution point while the 4,700 ohm resistor connects to a fourth eyelet near the tuning capacitor.

EARTH CONNECTION

This eyelet is earthed via a copper wire strap on the front of the matrix to the existing earthed eyelet near the tuning capacitor frame. Also anchored to this new point are the 2,200 ohm emitter resistor and the positive end of the 25 mfd bypass capacitor. The emitter of the transistor together with the other ends of these two components are anchored to a fifth eyelet directly below.

The collector is terminated on another eyelet, together with the 15 K collector load and .01 mfd coupling capacitor, the other end of which is connected to the seventh eyelet. A length of tinned copper wire is run between this point and the phone socket. Plastic spaghetti is used where crossovers occur.

Again we emphasise that the transistor leads should be left at their full length and soldered into circuit last of all, with the heat applied for the minimum of time. Precautions should also be taken against overheating when soldering the small capacitors and resistors into circuit. The suggested procedure is to hold the lead or pigtail in a pair of long-nosed pliers which will dissipate most of the heat.

To assist in soldering small components, sometimes in restricted space, it is helpful to use, ideally, a small soldering iron or, if this is not available, at least a small bit in a conventional iron. In an emergency a suitable bit can be made from a short length of heavy gauge copper wire.

There are no mechanical alterations required to be made to the set other than riveting the extra eyelets and when completed it will slip into the box as before, leaving room for the 4.5 volt battery.

If so desired, it is a simple matter to fit a back to the plastic case, plus a simple bracket for the battery. Something like this is really necessary if the set is to be used as a portable.

We used a scrap of 18 gauge aluminium, although 20 gauge would do as well and may be a little easier to handle. It may be quite easily cut to approximately the correct shape with a hacksaw, then trimmed to an exact fit with a file. The case we used had a recessed portion into which the back may fit neatly, held by a screw at each corner.

Suitable screws would be 1/8in Whitworth round head, and suitable holes will have to be drilled and tapped in the case.

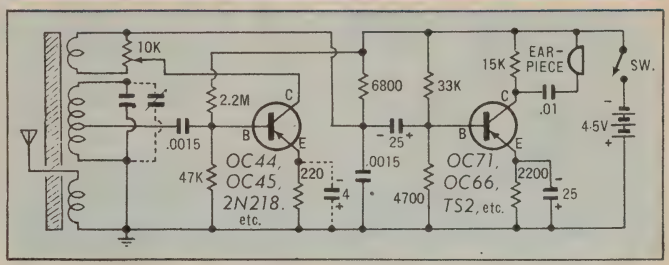
On the inside of the back a simple battery bracket or strap may be fitted, being formed to the general shape of the battery. This will prevent the latter sliding around inside, with possible damage to itself or other components.

Finally, it may be helpful to briefly restate the position regarding the various types of headphones.

In difficult localities best results will still be obtained from the conventional high impedance type phones, the only objection being their size and cost.

However, the extra stage should make it possible to use the miniature crystal earpieces in most cases, taking advantage of their small size and low cost. The low impedance disposal type phones are about equal to the crystal types in sensitivity, but have very little to recommend them apart, perhaps, from moderate cost in some cases. We would recommend them only as a temporary measure, and only if they happened to be on hand.

DETAILS OF THE SECOND STAGE

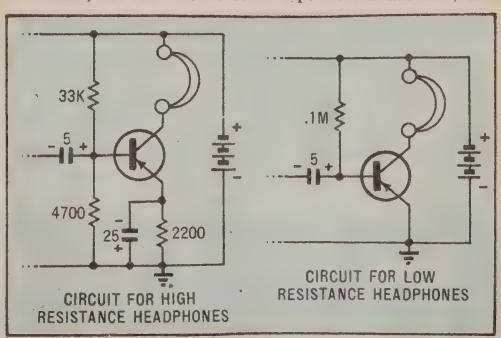


The first part of the circuit (left) is a repeat of the single stage described last month. Note the 6800 ohm resistor replacing the phones.

☆

Alternative connections for magnetic phones. Best results will probably be obtained from the high impedance types, which are recommended for weak signal areas.

☆



PARTS LIST

EXTRA PARTS FOR SECOND STAGE.

- 1 transistor OC71, OC66, TS2, etc.
- 1 5 mfd low voltage electrolytic capacitor.
- 1 25 mfd low voltage electrolytic capacitor.
- 1 .01 mfd paper or ceramic capacitor.
- 1 2200 ohm, ½ W resistor.
- 1 4700 ohm, ½ W resistor.
- 1 6800 ohm, ½ W resistor.
- 1 15 K, ½ W resistor.
- 1 33 K, ½ W resistor.
- 1 crystal earpiece.
- 7 eyelets for matrix strip.

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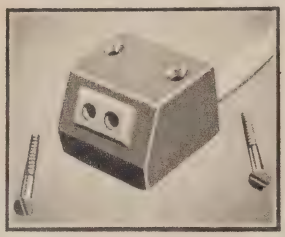
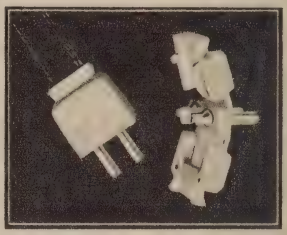


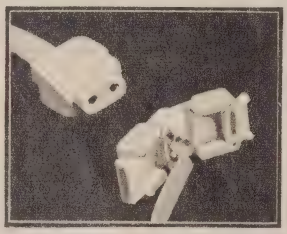
OUTLET BOX

Provides neat termination of 300-ohm ribbon feeder. Robust metal casing finished in bronze. Silver-plated contact sockets. Connections may be soldered or crimped. (LA5006.)



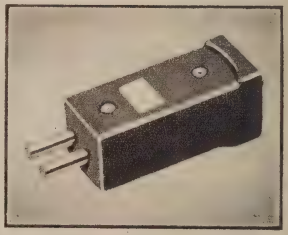
PLUG

A quick loading plug allowing soldered or crimped connection to 300-ohm feeder. Solid pins silver-plated for low contact resistance. (LA5007.)



SOCKET

Similar to LA 5007, having sockets in place of the pins to allow positive joints to be made in 300-ohm feeder. (LA5008.)



ATTENUATOR

Designed to interpose between LA 5006 or LA 5008 and LA 5007 where it is required to reduce the signal level: e.g., when high aerial directivity is required without the consequent increase in signal. Attenuation in values of 6, 12, 18 and 24 db. (LA5011/.)

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252 RF Coil	11/4
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175 Single Tuned IF 455kc	11/4
176 Double Tuned IF 455kc Med. Gain	11/4
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FROM THE SERVICEMAN WHO TELLS

The things some people do to radio sets provide a never-ending source of wonder for yours truly and, I suspect, for most of my colleagues. While many people, who know nothing about electronics are well aware of their limitations, there are always a few who, while just as ignorant, insist on "having a go." The results are often quite spectacular.

THE story I am about to tell is typical.

To my mind it ranks with the best assics from the past; stories about sets major components ruined by heavy-nded types who should never have en allowed closer to a set than the lume control — and then only after long course of instruction.

Remember some of them?

Remember the fellow who "lubri-ted" a rattling speaker voice coil with usehold glue? Or the one who stuffed e back of the speaker with wads of wspaper because it was "rattling" umming)?

UT IT OUT!

Probably the best one concerned the llow who, also faced with a rattling eaker, decided that, since it was the ne that was rattling, the speaker would better off without it. So he promptly t away the entire cone with a razor ade — and was quite surprised when could no longer hear any signals!

It probably is significant that these d many other "butchery" stories in-lve the speaker.

The speaker is one of the few parts of e set where there are any visible enomena and the "handyman" types, o may be wizards at repairing lawn-mowers, clocks, motor bikes, etc., are immediately attracted to anything that moves. This, they imagine, is one part they can understand, even if the electrical side still remains a mystery.

And so — "One new speaker please."

In other cases it is just plain carelessness. Some people seem incapable of appreciating even the most elementary instructions, or of observing them even when they understood them. Typical of this type is the fellow who leaves a set of discharged batteries in a portable all winter — then wonders why the set needs a major overhaul before it can be put in working order again.

This story involves a bit of everything.

The set was a well-known brand clock-style mantel radio of some four years vintage, and the owner appeared somewhat diffident as he pushed it across the counter.

"I don't know whether you can do anything with this, but Mr So-and-so (naming a regular customer) reckoned you'd be the best bloke if it could be fixed. Y'see, I had a bit of an accident with it."

To myself I wondered whether Mr So-and-so had really done me a favour. I had no doubts that he meant well, but tricky jobs — as this one apparently was — are not always the most profitable. Still it was nice to know he held me in such esteem.

So I merely asked, "What kind of an accident?"

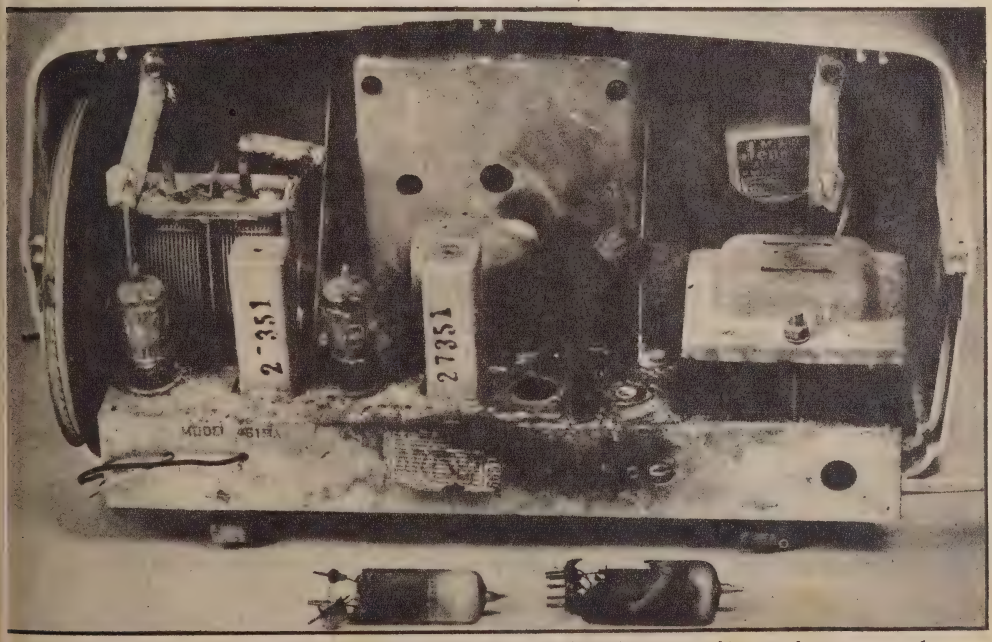
"Well, the cabinet was a bit grubby, see, and I decided it needed a bit of a clean up. I tried a damp cloth at first, but didn't do much good, so I tried some of the stuff the wife uses in the kitchen.

"That did the trick all right, and I managed to get a good polish on the cabinet. In fact, I felt pretty pleased with myself until I plugged it in and switched it on. Then there was a loud bang inside it, a flash of blue flame, and a lot of smoke out the back. And it wouldn't play."

Further questioning revealed that all this had taken place about a week ago, this being the first opportunity he had had to bring it into the shop.

WHAT WAS IT?..

The other point I was anxious to clarify was the exact nature of "the stuff" his wife used in the kitchen. Assuming that it had anything to do with the subsequent fireworks, which I was inclined to doubt at that stage, I reasoned that it must be a pretty potent solution. After all, he had only cleaned the outside of the cabinet with it.



Don't try to clean your radio with lots of water and a kitchen cleaner, or this may happen to you!

THE MAN SAID REPLACE IT WITH A NEW RADIOTRON PICTURE TUBE

I'm a grandmother, and, although my eyesight isn't quite what it should be, I always enjoy watching my favourite television programmes. Of course, I haven't the faintest idea how television works, so when the set broke down last week, I called the Serviceman and asked him to fix it.

He told me that the set needed a new picture tube, so I told him about the trouble the old tube had caused to my eyes and of the headaches and eye strain brought on by the over-bright glare of the picture tube. He said the tube with the very best picture was, in his opinion, the one most easy on the eyes, and was just what I wanted. Naturally I agreed, so the man said, "*Replace it with a Super Radiotron Picture Tube.*"

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It turned out to be a mixture used for cleaning sinks, baths, stoves, greasy saucepans, etc., and which I shall call "Useful Eustace." I refrain from using the real name, though I fail to see how the makers could be held responsible for anything that happened in a case like this.

Though it seemed a rather drastic way to treat a cabinet, I still could not imagine how it would be responsible for the electrical failure. It seemed more likely that this was something completely separate, the fact that both occurred together being mere coincidence.

ROUTINE JOB

And on that basis I simply noted the customer's comments and put the set on the shelf to take its turn, promising to advise him as to the extent of the damage before proceeding with the job.

When I finally took the set down off the shelf and had another look at it I had to admit that the owner had done a good job on the cabinet. It was spotlessly clean and shining like a new one. Perhaps "Useful Eustace" wasn't such a bad proposition after all.

But when I removed the rear half of the cabinet and looked inside . . .

The chassis was the most atrocious mess I have ever seen. Some idea of its condition can be gained from the accompanying photograph.

Centre of the mess appeared to be the four-pin plug and socket near the power transformer, used to connect the clock to the set proper. The chassis surrounding it was a blackened, sooty mess, while both plug and socket were just pieces of charred bakelite. In addition, the four pins in the plug had vanished, presumably as blobs of molten metal.

The blackening extended to the front of the chassis, for several inches either side of the socket, and to the rear and rear apron. The clock housing, speaker transformer (centre) and other nearby components had also received their share.

VALVES ALSO

Among them were two valves, the 6X4 and 6BV7, the first in front of the transformer, and the second near the rear of the chassis. In both cases the glass envelope was shattered and the valves were simply sitting on their wire supports. The socket of each valve was also charred and blackened.

The rest of the set was a mass of corrosion. The clock housing, the speaker transformer, power transformer, tuning gang, IF cans had all been attacked, while the chassis plating was erupting over almost all its area. It looked exactly as if someone had exploded a basket-bomb in the middle of it, then sprayed it with battery acid for good measure.

I have seen some pretty badly mutilated chassis in my time, including those salvaged from flooded homes and those, in portables, which have suffered the ravages of burst batteries, but I have never seen anything quite like this.

Exactly how all this happened must remain something of a mystery since, at the time of writing, I have only the owner's preliminary story to guide me. I can only assume that what he described as "cleaning" was more akin to washing; and in much the same manner as one washes the dog, by heaving a bucket of water over it.

Perhaps that is an exaggeration, but he must have sloshed on a lot of water with his "Useful Eustace." Since there was hardly a square inch of the chassis that was not corroded, I can only imagine he must have slopped it on with a wringing wet cloth, completely disregarding the join in the centre of the cabinet. It was fairly obvious that it was through this gap that the witch's brew had dribbled on to the chassis and components.

From this point on it is not hard to guess what happened. The mixture accumulated around the clock power plug to form a first-class short circuit. When the 240 volts hit it, things went off with a bang—literally—completely wrecking the plug and socket in the process.

It must have been a pretty violent explosion, since it not only blackened a goodly area of the chassis, but also had smashed the rectifier and output valves in the process. Just how these came to be broken is not completely clear, but I assume the instantaneous heat of the explosion was sufficient to crack the glass. Maybe there had been a few flying fragments for good measure.

WHAT WOULD IT COST?

Rather more important at the moment was the question of repairs. Would it be economical to restore such a set to proper working condition? I turned the chassis over and inspected the underside. Strangely enough, it didn't look too bad. There was some evidence of the explosion in the region of the 6X4 and 6BV7 sockets and a few spots of corrosion showing on the other sockets, but otherwise it was quite clean.

The worst single casualty appeared to be the power transformer. It was badly blackened and fairly obviously a write-off. This was confirmed when a check showed that the primary was shorted to chassis.

The tuning gang was another possible write-off. It was badly corroded on both the frame and the plates and, while possibly capable of being cleaned, probably would cost more in time than a new one.

On top of this there were two valves to be replaced and all the valve sockets. The latter would not cost much in themselves, but a fair amount of work would be required to rewire each one.

The outside of the speaker transformer was badly corroded but, knowing the type of inpregnation used on these, I felt there was a reasonable chance that it had survived internally. On the other hand, the IF transformers were a definite risk. There were spots of corrosion on the top of the cans, and a very real chance that some of the cleaning fluid had found its way inside.

Even if the windings checked OK at present, there was no guarantee that they would remain that way. To make quite sure there was no "kick back," it probably would be necessary to supply and fit new ones.

As far as I could tell without disturbing things too much (and I wanted the owner to see the set in exactly the condition it was in when I opened it), the

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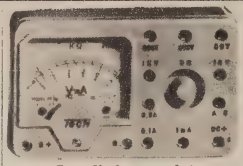

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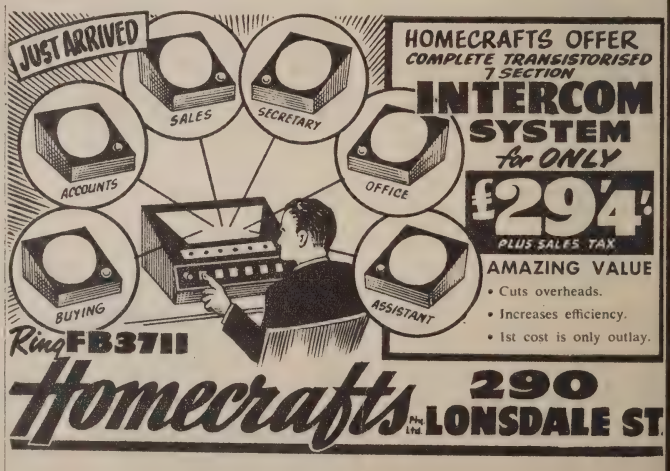

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ock probably had survived with no ore than the damaged power plug, ough, like the IF transformers, it pre- ted something of a long term risk.

But even without this, the list of com- nents and work involved was a pretty midable one. Power transformer, tun- g gang, valves, IF transformers, valve kets, re-wiring time etc., plus the expected which might turn up when e started pulling the set down. All ngs considered it rather savoured of king up the cabinet and running a w chassis underneath it.

OUBTFUL PROPOSITION

Adding it all up, I very seriously ubted whether it was worth while ing to salvage the set. It was up to owner of course, but I felt bound advise him that repairs would be ite costly, and probably more than set was worth.

And there, for the moment, the mat- rests. Even though it is several weeks ice the owner delivered the set to me, have not seen him since. A couple of ssages I have sent him have been knowledged, but that is all. I think he obably realises that the news concern- g the set will not be particularly good, d is therefore putting off the evil day.

Of one thing I am sure. I'll wager our end will leave "Useful Eustace" in the chen after this. Maybe he does a good b on sinks and saucepans, but as for dios . . .

That must have been the most expen- e cabinet polishing job anyone ever dertook.

And, since I have nearly exhausted y allotted space, I will finish with a ort story from the workshop.

It commenced with a rather frantic onday morning phone call from the enage daughter of one of my regular stomers. After identifying herself she urted out, "I dropped a transistor dio in the surf yesterday; would you ve a look at it and tell me how badly s damaged?"

Then she added rather hesitantly, "It esn't play any more."

"I'm not surprised at that," I replied, t doesn't usually do them much good. fact, I think it is only fair to warn u that it could be very seriously dam- ed."

NOT MINE"

There was a few moments' silence at e other end of the line. Then, "It's not ine, I only borrowed it for the day. y friend's father brought it back from merica. It's going to be awful if I n't get it fixed."

"Well, it doesn't sound particularly peful," I replied, "but bring it in and ll see what can be done."

Much and all as I deplore what teen- ers and transistor radios do to our aches, I couldn't help feeling sorry for is particular lass. An accident like that bad enough when one's own property involved, and a good deal worse when is someone else's. But it is a real agedy when, as in this case, it is a oreign" item for which there are un- tely to be any spare parts available.

And of all the accidents, immersion, rticularly in salt water, is probably e worst. If a set is dropped or trodden there is a good chance that only one two components will be involved, but dunking means that every part is tely to be damaged. Given time, salt water can do as much damage as "Useful Eustace."

The more I thought about it the worse the picture became. What about the speaker, with its paper cone and tiny annular gap? Or the gang, probably made from aluminium, and to very close tolerances? Or the coils, wound with very fine wire and highly susceptible to corrosion?

On the other hand, just how severely had the set been immersed? Knowing the common tendency for the female of the species to exaggerate, particularly under stress, I realised that "dropped in the surf" could mean anything from having it fished out by an obliging skin diver to nothing more than a bad splash from somebody's horse-play.

Since this was important, I made it my first line of inquiry as soon as the lass presented the set for examination. It seemed that it was somewhere in between the extremes I suggested above, having been dropped on the sand in the path of an oncoming wave, and fairly close to the high water mark.

LOOKED BAD

As a result the water had surged around it just as the wave reached its peak but, probably, with a depth of only a fraction of an inch. Nevertheless, it must bave been a nerve-racking sight.

Further questioning revealed that the set proper, in a plastic case, had been further protected by the traditional leather case, in which it was still enclosed. Also that, immediately after the accident, about "half a cup" of water had been poured out of the combination. How much of this had been held by the leather case and how much might have penetrated the plastic case I had no way of knowing.

Opening the set revealed a surprising lack of damage. As far as I could see, the only casualty was the battery and the battery contacts. The former was discoloured as if by water and the latter corroded. Otherwise everything appeared clean and dry.

On an impulse I removed the old battery, cleaned the contacts, fitted a new one and switched on. And, presto, it gave forth music. To be sure, it was from the ABC, and probably dreadfully "square" by teenage standards, but I'll wager it was the sweetest music that lass had ever heard.

For the most part the set appeared to work perfectly, the only obvious fault being mechanical grinding noises when either the volume or tuning control was adjusted. The cause was equally obvious; fine particles of sand which had found their way under the respective knobs.

OVERHAUL

In order to correct this, and for other reasons, I suggested that the set be left with me for a few hours. I wanted to give it at least a preliminary overhaul to confirm the impression I had now formed that very little water had actually reached the inside of the set.

And so, in fact, it proved to be. The most careful examination I could make, without pulling the thing to pieces, showed no evidence of water damage. Had I not been told I would never have suspected there had been such an accident.

But I did find a remarkable amount of sand. Apart from that trapped under

(Continued on Page 61)

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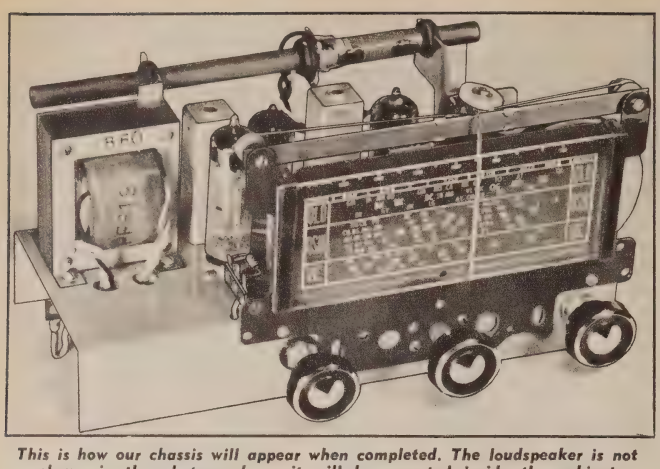


This is how our chassis will appear when completed. The loudspeaker is not shown in the photograph as it will be mounted inside the cabinet.

Little General For 1961—Part One

Among the most popular projects we have ever described have been the various "Learn While You Build It" series, designed to allow the raw beginner to build a full size receiver in easy stages. Because they were so popular, we are presenting a brand new series around a high performance 3 valve mantel set. This article tells you how to get started.

By Alan Nutt

IN spite of the development of other types of sets, there is no doubt that the simple AC operated mantel remains a firm favourite. It is popular with users generally because of its high performance, and popular with the home builder—particularly the beginner—because it is a full size set he can build with confidence.

This is emphasised by the fact that we still receive many requests for the small AC operated receivers. Beginners in radio as well as those who have been out of touch for a number of years apparently feel that this provides their best chance of breaking into this fascinating hobby. For this reason then, we present our 1961 Little General.

SIMPLEST SUPERHET

While certainly not the simplest of receivers (what could be simpler than a crystal set?), it is, nevertheless, about the simplest of the superhet type that one can construct. We intend to describe this little set in a stage-by-stage manner, keeping in mind those younger readers who have definite limitations on available finance. At the same time, this allows a more detailed discussion of the various circuit functions than would otherwise be possible.

The finished receiver will be a very attractive little mantel set and, although containing only three valves plus power diodes, will give a very satisfactory performance using its built-in ferrite rod aerial.

We plan to cover the construction and theory of the power supply and audio amplifier stages in this article, the addition of the IF amplifier in the next, followed by the converter stage and alignment details.

In the final article, we hope to describe a cabinet that will be in keeping with modern styling and at the same time be relatively simple to construct. Although a receiver may function well, much of its appeal is lost unless it is also good from an aesthetic point of view, so the time spent in constructing a cabinet is well worth while.

This month's section (the audio amplifier and power supply) employs one double purpose valve type 6BM8, a power transformer, two 1N1764 silicon diodes, a number of resistors and capacitors, plus several minor components. Take a look at the circuit and see if you can recognise these.

We have incorporated silicon power diodes in the rectifier circuit, mainly because of the saving in heater current but also because of their small physical size and simplicity of connection.

The power supply is a conventional full wave type and its action may be considered in some detail in order that the constructor may become familiar with its operation and the part that each component plays.

For the present, let us ignore the 4 ohm resistor between the centre tap of the high voltage secondary winding and chassis, as it plays no part in the function of this part of the set. We will have more to say concerning it next month when dealing with the IF amplifier stage. Assume, therefore, that the centre tap connects directly to chassis.

TRANSFORMER WINDINGS

The transformer consists of a primary winding connected to the 240V AC supply and two secondary windings. The larger of the two secondary windings is the high tension winding and is best considered as two 150 volt windings connected in series, with their junction brought out as the centre tap. The other winding supplies 6.3 volts for the valve heaters.

The 1N1764 diodes are used to rectify or change the alternating current from the transformer into direct current for the high tension (HT) supply. We normally require a positive DC voltage for this, the use of AC being quite useless. If used, the valves would function only during the positive half cycles and the resulting hum in the speaker would be intolerable.

A characteristic of any diode, whether it be of the semi-conductor or valve type, is that it will pass current readily in one direction only. If the anode is made positive with respect to the cathode current will flow; if the applied voltage is reversed and the anode becomes negative, little or no current will flow.

So, if alternating voltage is applied to a diode, current will flow only during the half cycle in which the anode is positive with respect to the cathode. Considering the top 1N1764 diode and the top half only of the high-tension secondary, it can be seen that the transformer, diode and the first 16 mfd. capacitor are all connected in series.

CONDUCTING CYCLE

When the polarity of the voltage is such that the diode anode is positive current will flow through the diode charging the capacitor to approximately the peak value reached by the voltage during the half cycle. On the negative half cycle, the diode will stop conducting and the capacitor will partially discharge through the load which, in this case, consists of the valves in the receiver.

Since the capacitor receives a charge on only one half cycle, this is called "half wave rectification." It suffers from the disadvantage that the capacitor will discharge appreciably during the negative half cycle period, causing a fall in HT voltage. This becomes apparent as a 100 cycle hum in the speaker.

For this reason we normally emplo

full wave rectification," and this may be explained by considering the lower half of the transformer and the lower diode. During the half cycle that the top diode is not conducting, the voltage polarity of the transformer will be such that the anode of the lower diode is positive. This will cause this diode to conduct and, by following the circuit through, it will be seen that it will also charge the first filter capacitor, and in the same polarity as the upper diode.

This means that the gaps between the positive pulses from the top diode are effectively filled in by the pulses from the bottom diode, each diode supplying a charging pulse on alternate half cycles. The effect is to reduce to a very large degree the amount of AC "ripple" contained in the DC output from the supply.

FILTER CHOKE

In order to further reduce the ripple voltage, a filter choke is often used in series with the DC ouput lead. The action of the choke is to resist any tendency for the current flowing through it to change in value, and it thereby adds further to the smoothing of the DC output voltage. In simpler circuits, such as this one, a resistor may be substituted for the choke. Although not as effective, the resistor has the advantage of low cost and small size. When used with capacitors of adequate value, the overall result is quite satisfactory.

Finally we provide a second filter capacitor for further smoothing to eliminate the last trace of ripple. This capacitor has another function, often overlooked, whereby it provides a low impedance path for various signals which appear across the power supply.

Turning our attention to the amplifier section of the set we will endeavour to explain the general principles of amplification, at least to the point where the reader can get a good general picture.

This part of the circuit uses two valves, in the electical sense, although there is only one valve in the physical sense, both sections being accommodated in the one envelope. The section using pins 1, 8 and 9 is a triode (three elements) while pins 2, 3, 6 and 7 belong to the pentode (5 element) section.

SIMILAR FUNCTIONS

Both sections function as amplifiers and both operate on the same general principle. Difference are more in detail, and the use of each type for the job best suited to it.

The important elements in each section are the cathode (pin 8 in the triode and 2 in the pentode), the grid (pins 1 and 3), and the plate (pins 9 and 6). In operation the cathode is connected to the negative side of the HT supply and the plate to the positive side (via a suitable load).

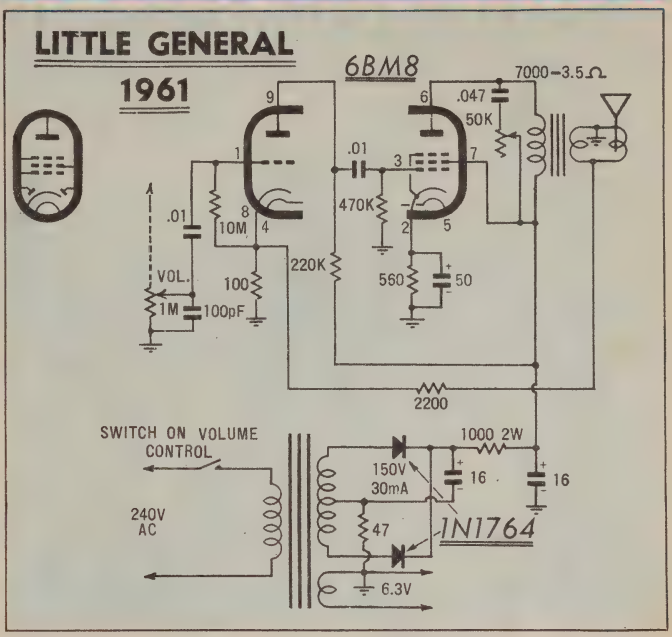
When the cathode is heated (by the heater) it emits electrons which, being negative, are attracted to the positive plate. This flow of electrons really constitutes an electric current, meaning that we are able to bridge the gap between cathode and plate even though there is no obvious conductor.

When a valve operates as an amplifier, the application of a voltage to the control grid has an appreciable effect on this current flow between the cathode and plate. Due to the close proximity of the grid to the cathode, a negative voltage on the grid can, if the voltage is sufficiently large, prevent any electrons that leave the cathode surface from passing across the plate, the negative field surrounding the grid wires being sufficient to repel the negatively charged electrons back towards the cathode.

As the negative grid voltage is reduced, some electrons will be able to pass between the wires of the grid mesh and so reach the plate. At this point we say that plate current commences to flow. Reducing the grid voltage still further will result in a steady increase in plate current until the point is reached where the grid voltage passes through zero and begins to go positive with respect to the cathode.

When this occurs, the plate current will increase rapidly and, at the same time, some of the electrons from the cathode will be attracted to the grid because of its positive charge. This constitutes a flow of grid current. If the grid current is excessive, owing to a prolonged application of positive grid volts, the valve can be seriously damaged by overheating of the grid and plate and the release of gas within the valve envelope.

In normal amplifier application, the grid voltage is preset or biased to a particular value up to several volts negative with respect of the cathode. Alternately if the cathode is biased in the positive direction, the same conditions apply. We can say that either the grid is negative



The circuit diagram should be used in conjunction with the wiring diagram so that the use of the symbols may be clearly understood. Be careful of the polarity of the silicon diodes and the electrolytic capacitors.

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1 5in elliptical speaker (Rola type F or similar).
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2 1N1764 silicon diodes.

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1 470K.
1 220K.
1 2.2K.
1 1K 2W (Or 2 2.2K 1W in par).
1 560 ohm.
1 100 ohm.
1 47 ohm.
1 1 megohm potentiometer with SPST switch.
1 50K potentiometer.

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2 .01 mfd. 200V paper.
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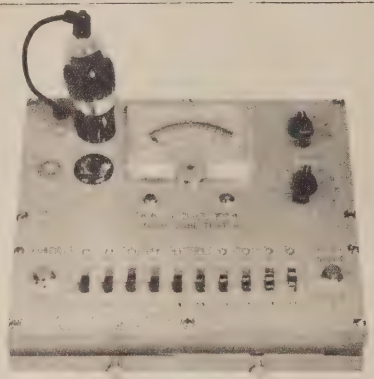

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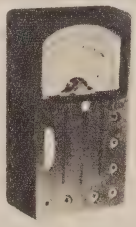

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respect to the cathode or that the ode is positive with respect to the

we now superimpose on this DC voltage an AC signal voltage, this alternately add to and subtract from bias voltage. Providing the peak litude of the AC voltage does not e the grid voltage to swing positive ne direction or drive the plate cur- to the cut-off point in the other, the e current of the valve will follow tly the changes in grid voltage.

y placing a resistor, or load, in the rnal plate circuit, we can obtain a nging voltage drop across this load ch will be many times larger than original voltage applied to the grid.

AMPLE

s an example, let us assume that er certain conditions, a voltage nge of one volt between the grid and ode of a valve produces a change of ent in the plate-cathode circuit of A. If the load resistor in the plate uit is 10K ohms, there will be nge in the voltage drop across this tor of 20 volts. We can then say under these particular conditions valve has a gain of 20. In other ds, for a one volt input, we have ined 20 volt output.

he load in the plate cricuit need not essarily be a resistor. It can be an io choke or a transformer and the lts will be similar. However, for age amplification purposes it is more al to use a resistor for reasons of nomy. Where power amplification is prime consideration, transformers are mally employed.

n our case the triode section of the M8 has a plate load resistor of 220K ns. The grid bias voltage is develop- across the 10 megohn (10M) resistor he grid circuit. Due to contact poten- or heating effect on the grid struc- e, minute grid currents will always be sent and, by providing a high value resistance to cathode these small cur- ts can develop sufficient voltage across resistor to be used as bias voltage.

The 100 ohm resistor in the cathode uit may look like one type of bias uit at first glance, but this is not its ction. Its purpose will be discussed detail a little later on.

A potentiometer is used ahead of the de amplifier as a means of adjusting input signal to the control grid and, mately, will control the level of sound m the loudspeaker.

TERSTAGE COUPLING

The output voltage developed across plate load resistor is coupled to the trol grid of the pentode section of 6BM8 by a .01 mfd capacitor. This allow the passage of the audio sig- but effectively prevents the positive voltage on the plate of the triode m appearing on the grid of the pen- e. If this were allowed to occur, the s voltage for the pentode would be et and the valve liable to damage as ntioned earlier.

The bias for the pentode valve is ained by means of the 560 ohm hode resistor, the 50 mfd capacitor nting it providing a low impedance h for the AC signal applied between l and cathode. The plate load in this tion is the speaker transformer which nsfers energy from the plate circuit the valve to the loudspeaker for con-

This photo shows how the larger components are mounted above the chassis. Note the feedback resistor mounted on a tag strip just to the left of the speaker transformer.

version into audible sound.

The output valve is designed to work into an optimum value of load impedance and the speaker transformer performs the function of matching or transforming the very low impedance of the speaker voice coil to the relatively high value of impedance required by the plate circuit of the valve.

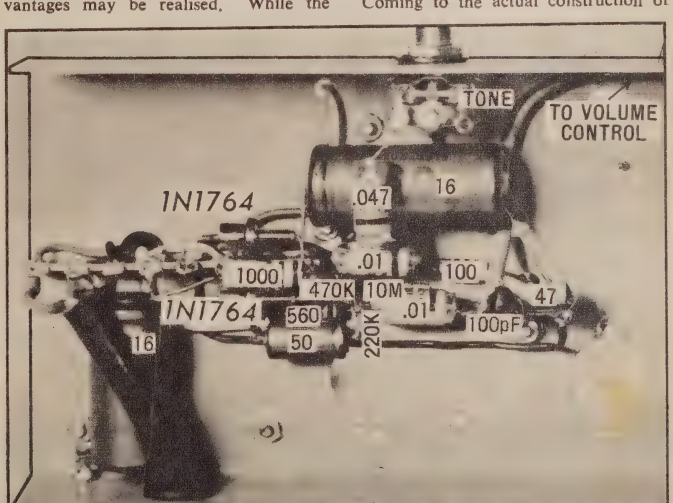
Th tone control consists of a capacitor (.047 mfd) and resistor (50K) in series across the primary of the speaker transformer. The high frequency components in the signal at the plate of the valve are shunted through the capacitor and do not appear in the output from the loudspeaker. The amount of shunting is determined by the value of resistance in series with the capacitor.

The final point to be considered is the application of negative feedback. By taking some of the output voltage and returning it to the input of the amplifier in such a manner that it subtracts from the original input signal a number of advantages may be realised. While the gain of the amplifier is reduced, at the same time the distortion and noise generated within the amplifier are also reduced. The overall effect is a very worthwhile improvement in quality.

In this circuit the feedback voltage is derived from the speaker transformer secondary. Connected across it is a 2200 ohm and 100 ohm resistor in series, the latter also forming part of the triode cathode circuit. Since the input voltage to the triode also must appear across this resistor, we can arrange for the feedback voltage to cancel some of the input voltage. However, it is vitally important that connections to the transformer be the right way round, so that the feedback is "negative."

If the output transformer secondary leads are reversed, the feedback voltage will be so phased that it will add to rather than subtract from the input voltage. The effect will be cumulative and the end result will be severe oscillation. (Positive feedback.)

Coming to the actual construction of



All components in the audio and power supply sections are visible in this under chassis photo. Note that the power leads to the volume control switch are not shown, being added after the photo was taken.

THE WARBURTON FRANKI PAGE

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is section of the set we have tried to esent as much information as possible the form of diagrams and text, so that en a beginner should have no real oblems.

The first step is to obtain a kit of parts detailed in the parts list. These should available from a number of our advtisers, and a complete kit makes the ıole job a good deal easier. The assis also should be available as a ady made item, and we strongly remmend that one of these be used. ueprints will be available if you wish make your own, but it is unlikely at much will be saved.

SSEMBLY

The next step is the assembly. All e large components, power and speaker ansformers, potentiometers etc., plus e valve socket and tag strips should mounted on the chassis, using the assis photographs and diagram as a ide. Note particularly the correct ientation of the valve socket.

Now we may commence the wiring, arting with the power supply. The layt is not critical, but should be adred to reasonably accurately if a neat b is desired. The transformer leads are rminated on the eight terminal tag rip, as are also the silicon diodes and e 1000 ohm filter resistor. Note carelly the anode and cathode connections the silicon diodes.

The two 16 mfd filter capacitors may wired next, then the heater pins of e 6BM8, followed by the HT lead om the filter resistor to the screen pin) of the 6BM8. This pin will become e HT point for the rest of the set.

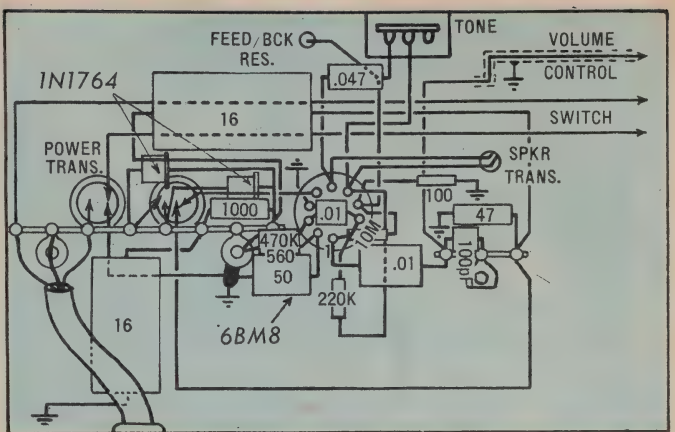
The 220K plate load resistor for the iode section of the 6BM8 will evenally be connected to the HT pin on e second IF transformer, but as this mponent has not been included yet, it ay be connected across the socket of e valve between pins 7 and 9 for the ne being.

The .01 mfd coupling capacitor from e volume control to pin 1 of the 3M8 is mounted between one lug of e three lug terminal strip and the pin the valve socket. The shielded wire ecified should be used for the volume ntrol leads. Failure to do this may relt in hum being picked up from the wer transformer or heater wiring.

EEDBACK CONNECTIONS

The 2200 ohm feedbeck resistor is ounted above the chassis on a third tag rip and is quite easily seen in the notograph. Two leads, one from the rth lug and the other from the unounded end of the secondary should run from this tag to the speaker ice coil. We have not shown the eaker in the photographs, as it is inded that it shall be mounted in the binet, screwed to the baffle rather than the chassis itself.

Finally, a word about the "earth" or assis connections. As might be imaged, these are simply electrical connecons to the chassis, the latter forming ie side of the circuit. However, in pracce, some difficulty might be experienc- in making such connections, particurly to a steel chassis. Steel is not easy solder, so normal practice is to anchor small solder lug under a convenient lt, and use this for the chassis conection.



Followed carefully, this wiring diagram will assist considerably in placing the various components and wires in the chassis. Always count the valve socket pins in a clockwise direction from the key position.

However, even this is not completely satisfactory. The chassis will need to be cleaned to remove paint, etc., if a good connection is to be made, and there is no guarantee that rust will not upset the connection at a later date. For this reason it is a good idea to connect all these points together with a length of bare tinned copper wire, say 18 gauge.

On completion of the wiring, it is best to check it very carefully for any errors which may have crept in. Do not neglect this little chore as it may mean saving a valve or transformer from damage.

SWITCH ON

When quite certain that the wiring is in order, plug in the 6BM8 and switch the set on. The heater of the valve will light almost immediately and should be plainly visible through the glass envelope. After about 20 seconds of warm-up time have elapsed, the set may be tried for correct functioning of the audio section.

Advance the volume control and place a finger on the unused lug of the control. If the set is working in a normal manner, a healthy hum will be heard from the loudspeaker. If the set should break into oscillation, switch off the mains and reverse the two speaker transformer secondary leads. This will provide the correct phasing for the feedback voltage as mentioned before. Without a detailed examination of the transformer, it is not possible to determine beforehand which is the correct way round to make the connection, but at the worst, one has a 50-50 chance of being correct the first time.

As a further test, the gain of the amplifier may be noted with and without feedback. If the phasing is correct and the feedback negative, application of the feedback should cause a decrease in gain. Any suggestion of an increase is wrong, even if oscillation is not immediately obvious.

All right, the set hums as it should, what now?

Even in this simple form, the set may be used as a crystal pickup amplifier. Simply connect the pickup across the two outside terminals of the volume control, the shielded lead from the pickup connecting to the earthed lug.

If used in this manner simply for testing, the speaker need not be mounted in any way, but, if it is to be used for serious listening, some form of temporary cabinet should be provided to improve the bass response.

Next month we will add the IF amplifier valve and the IF transformers, which will take us one stage further in the construction of our mantel receiver, while still permitting the use of the audio section with a pickup if so desired.

SERVICEMAN WHO TELLS

(Continued from Page 55)

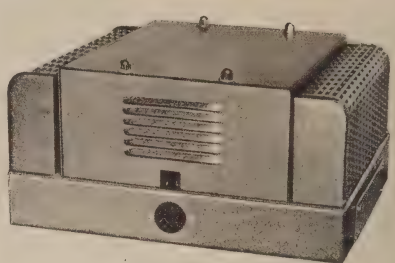
the controls, it was also between the gang plates and in quite a few other places. In fact, it is quite surprising the places where these particles will penetrate after frequent exposure to sandy conditions.

While not nearly as serious as in the case of, say, a watch or camera, they nevertheless can cause a lot of bother. But, I suppose, that is one of the penalties of taking the set to the beach. And, if one can't show it off on the beach, what's the point in having a transistor set?

In this case, it was merely a matter of cleaning it out carefully and putting everything back together again. And, when the teenager, still somewhat subdued, called in a few hours later I was able to assure her that the set was behaving as well as new. Further, as far as I could see, there was little risk of long term failure, though it could not be ignored completely.

Whereupon she heaved a mighty sigh of relief and expressed the opinion that she would probably be able to sleep that night. She also declared quite solmnly that she would never ever again take a transistor radio to the beach — particularly if it belonged to someone else.

Well, that's one less, I suppose.



THE SOUND SALES A/Z TWIN TWENTY STEREOPHONIC AMPLIFIER AND TONE CONTROL UNIT

TECHNICAL REPORT

Reprinted from "The Gramophone"

FOR many years the amplifier systems produced by Sound Sales Ltd. have been respected as well designed and engineered equipment. With the advent of stereophonic discs and tapes the manufacturers have designed a completely new equipment consisting of two units, a combined two-channel 10-watt power amplifier, and a separate control unit, the excellent presentation of which caused the Council of Industrial Design to include it in their recent exhibition of high quality sound apparatus.

Power Amplifier

This consists of two separate 10 watt power amplifiers fed from a common power supply. The input to the amplifier is taken from an octal socket which also supplies power to the control unit. The socket is R.C. coupled to the first valve amplifier stage that uses a low noise Mullard EF86 pentode. Direct coupling is used to a Mullard ECC82 phase splitter stage with a phase correcting network in the anode circuit of the EF86. Two signals at 180 degrees apart are R.C. coupled to the push-pull output stage using Mullard EL84 valves. This stage operates under ultra-linear conditions, the screen of the EL84 being connected to a tapping on the massive output transformer. The two amplifiers are identical in design and layout. Power for the two 10-watt amplifiers, the control unit and for a tuner is derived from a heavy power transformer, and Mullard GZ34 full wave rectifier. Choke and electrolytic capacitors are used to keep the 100 c/s ripple voltage on the H.T. rail to a minimum. Adequate decoupling by R.C. smoothing is used for the first and second stages.

The problem of keeping mains hum to a minimum has been approached by keeping the power lead to the control unit separate from the multi-leads feeding the main amplifier, and using a separate heavy duty mains on-off switch on the pre-amplifier control unit. A single 750 mA fuse is used in the negative H.T. supply line with current limiting resistors.

The layout of the components on the 12¼in by 10in by 6¼in high gold hammered chassis is of interest. In the centre of the chassis is mounted the power transformer and smoothing choke. Near to each 10in side of the chassis are mounted the valves, access to which is made by hinged ventilated streamlined cages. The centre of the chassis and its components is covered with a detachable inverted chassis that completely screens the iron cored transformers and chokes from the valves. Below the main chassis the various smoothing electrolytic capacitors are mounted, thus ensuring that they do not operate at elevated temperatures, a point often forgotten by many designers. All the various resistors and capacitors used for the valve circuits are neatly mounted on good quality insulating boards, and in the remote case of component failure they are readily accessible and replaceable.

The output transformers are worthy of comment. Using grain orientated laminations, they are somewhat large by modern standards due to the sectionalising. The transformers are fully impregnated against humidity and, like the mains transformer and choke, are quite silent mechanically. The secondary winding is tapped to accommodate loudspeaker impedances of 3, 8 and 15 ohms. I like the use of four-pin valve sockets as the output connections in conjunction with solid plugs, for it simplifies the phasing of loudspeakers which, once they are correctly phased, require no further attention. Feedback over the amplifier is taken from the secondary winding back to the cathode circuit of the EF86 valve.

Measurements and listening to this equipment have extended over several weeks and the following tabulated list compares the manufacturer's literature with measured figures. For these measurements the following technique was used. A Dawe R.C. oscillator giving a pure sine wave or a Hewlett-Packard square wave generator was connected through a Marconi A.F. attenuator to the input of the amplifier circuits. Also across the input circuit an Airmec milli voltmeter measured the sine wave amplitude. The two output transformers were connected to Heathkit or Marconi A.F. wattmeters, a Cossor double beam oscillograph and a Marconi distortion factor meter.

Manufacturer's Specification	Measured figures
Power Output:	
10 watts per channel.	10 watts
13.5 per channel	14 watts
Distortion:	
0.065 % per channel	0.08 % and 0.085 %
Sensitivity:	
100 m V per channel	45 m V for 10 watts
Hum and Noise:	
better than — 80 db	—82 db at 10 watts
Feedback: 20 db	20 db
Damping Factor: 21	20
Margin of Stability:	
Not quoted	8 and 9 db
Power Consumption	
with control unit— 105 W	108 W at 220 V. 50 c/s A.C.
Frequency Response:	*at 1 watt output:*
Flat 20-25,000 c/s	Flat 30-20,000 c/s —2 db at 20 c/s —1 db at 22 Kc/s —2 db at 30 Kc/s —3.5 db at 40 Kc/s

The figures quoted above are proof of the actual performance of the power amplifier compared with the published performance. Taking 1,000 c/s as a reference frequency, the following table gives the power output with a constant input signal:

Frequency c/s	20	30	100
Power output W	7	10	10

then flat power output to 15 Kc/s falling to:

Frequency c/s	17K	27K	36K
Power output W	8	6	4

After these figures were taken with sine wave inputs the amplifier was fed with a square wave generator and non-inductive 15 ohm resistors were connected across the output transformers. Also across the output terminals was connected a Cossor double beam oscil-

aph, thus displaying simultaneous in-
iation from each channel. There has
much technical argument as to the
lity of square wave testing for, un-
the person taking measurements
had considerable experience in os-
graphic work and the interpretation
ie beam tracing, quite erroneous de-
ns can be made. Probably sine
red pulse testing is a better method,
unfortunately no manufacturer has
made suitable commercial measur-
ipparatus. Experience indicates that
Sound Sales power amplifier fully
s its designer's claims, giving an ex-
nt transient response with very little
shoot on the leading edge of the
.

Control Unit

ich channel of the twin channel pre-
ifier and tone control unit consists
low noise Mullard EF86 R.C. stage
an eleven-position input selector
h. Feedback from the anode circuit
ie grid circuit compensates for the
us recording characteristics. In the
circuit of the second stage, one-half
Mullard ECC81 is the inter-channel
ice control. Between this resistance-
city coupled stage and the second
of the ECC81 are the bass, treble
presence variable controls. The cir-
used here are based on the Baxen-
arrangement published in the "Wire-
World," and one of the most versa-
to date. The volume control is in
output circuit of the second half of
ECC81. All the controls are ganged
are carefully selected and measured
itiometers.

ie appearance of the control unit
ws the pattern set a few years ago
ound Sales and which has met uni-
l approval. The front panel mea-
11in by 4½in and consists of a
ntine bronze overlay panel which
be mounted in a cabinet with four
, the cut-out in the cabinet being
8in by 4½in. Behind the bronze
lay panel is a second chocolate-
ired panel carrying printed labels
he various controls. A completely
parent sheet covers the chocolate
l so that it cannot be scratched or
r-marked. The following controls are mounted on the front panel reading left to right: eleven-way switch selector, bass control, balance control, input and output jacks for mono tape machine, presence control, treble control and volume control. Also on the bottom left-hand side is a mono/stereo two-position switch balanced at the right-hand bottom corner by a heavy A.C. mains on/off switch.

The whole of the control unit is fully screened in a gold hammered finished metal chassis with removable top and bottom screens. Connections for the various input circuits are made by means of a 20-way input connector strip. There are also three screened phono sockets for low level inputs from gramophone pickups. Connection to the main amplifier is made with a multi-way cable terminating inside the control unit and measuring 3ft long.

The following table compares the manufacturer's published figures with those measured with the same apparatus used for the power amplifier:

Manufacturer's Specification	Measured figures
Sensitivity:	
Microphone—1.4 V (obvious misprint for 1.4 millivolt)	0.7 mV
Tape recorder playback—125 m V	95 mV across 0.25 M. ohms
Radio inputs (3) — 30 m V	10 and 11 mV
Pickup, crystal, mono or stereo —100 m V	66 mV
Tape inputs, high impedance—14mV	11 mV
Bass control:	
+18db to − 20 db	+18 db at 50 c/s −21 db at 50 c/s
Treble control:	
+ 10 db to − 27db	+12 db at 15 Kc/s −24 db at 15 Kc/s
Cross-talk:	
at 1 Kc/s −45 db at 10 Kc/s −32 db	−48 db −30 db

All the quoted measured figures are the inputs required to produce 10 watts across a 15-ohm non-inductive load and the bass and treble control ranges quoted relative to 1,000 c/s. Again it will be noted that the measured figures substantially confirm the maker's claims, the apparent additional sensitivity being partly due to the higher overall amplification of the power amplifier.

Measurements, however accurately and carefully made, can only be part of an assessment of the quality of an amplifier. They convey nothing about the convenience of the controls, the logical wiring of the various input channels, the versatility of the various controls or their quietness and smoothness in operation. Both the ganged input switch and the volume control use large fluted knobs with positive position marking which is visible from any angle. The other four variable controls use serrated edge control knobs which do not slip even with light finger pressure. All the controls are finished in cream and the central four with gold inserts. With the index markings set vertically a substantially flat response curve is obtained.

The facilities offered by the input selector switch cover every possible combination of tape, radio, pickup, etc., all in mono or stereo conditions. The compensation circuits for records and selected by the input switch cover 78 r.p.m. old European recordings, RIAA mono records after 1954, LP British mono records before 1954, LP RIAA stereo and LP records after 1954, LP U.S.A. recordings made in the U.S.A. to other American standards. For users of pre-recorded tapes there are switch positions for recordings made to the CCIR standard curves or to the American NARTB equalised curves.

For some time I have enjoyed using this amplifier with a pair of senior Whiteley columns supplemented with a pair of Kelly ribbon speakers. Background hum and noise with a good F.M. tuner or a Decca ffss stereophonic pickup are practically inaudible. The controls are dead quiet in operation and, with an undistorted power output of 10 watts per channel, its output is more than adequate for the largest listening room. The design of power amplifiers in particular has now reached the stage where the products of the best manufacturers reach a specification as near perfection as practical, and it would be a very brave person who could claim to hear any difference between them. The pre-amplifiers and/or control units give greater scope to designers and again the main difference between the best manufacturers lies in the facilities that they offer. If you wish to have a wide range of input circuits, correct compensation for the many recording characteristics and the minimum of variable controls, then the Sound Sales Control Unit is well worth investigating.

WHY ANOTHER STEREO AMPLIFIER?

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do not consider the Sound Sales 20 Watt to be just another good amplifier; we consider it to be the best irrespective rice. Mr Norman Crowhurst in an article in R., TV and H., said that even with identical specifications one amplifier sound better than another.

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kmanship with a solid **and heavy** construction so lacking in most amplifiers, neat layout and easy access to all com-nts. (The review will tell you the rest.)

ilities

controls give a range and flexibility of operation rarely encountered in modern amplifiers. Where most amplifiers a single input for magnetic, the A.Z. uses different compensation positions. (See review.) **We have waited for the oved version** of the review model which has increased sensitivity giving that big feeling of grandeur and spaciousness. **riable top cut filter** ensures the best reproduction of your worn recordings. We realise that talk is cheap and only ask to listen at your nearest quality high fidelity centre.

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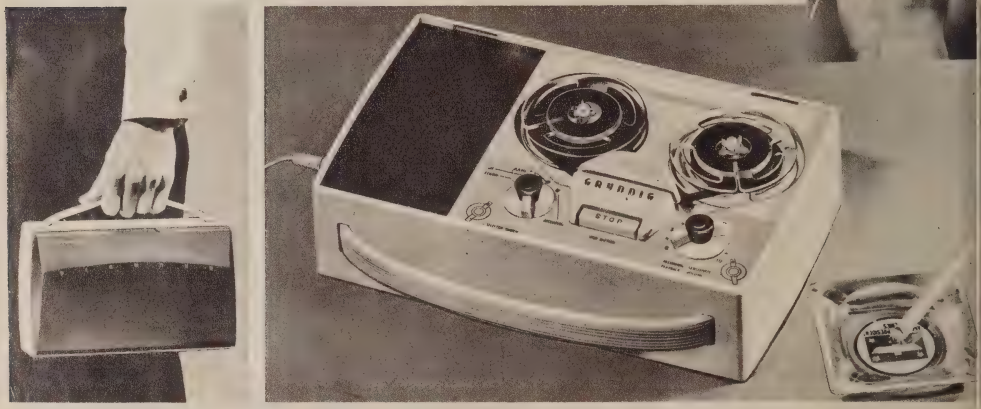

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NARROW BANDPASS IF FILTERS

The crowded conditions prevailing on the shortwave bands today has resulted in much thought being put into the subject of obtaining good selectivity in receivers for these bands. This article has been written in an attempt to define the amount of selectivity desirable and the methods commonly used to obtain it.

By Keith Jeffcoat

SELECTIVITY in shortwave receivers has always been something of a roblem. The introduction of the super-eterodyne principle meant that IF chan-els could be used sufficiently low in requency to obtain much greater de-rees of selectivity than had ever been ossible before, and did for a time solve ie problem.

As more and more stations began to ccupy the shortwave bands however it ecame apparent that even greater de-rees of selectivity were necessary. hannel widths became progressively re-ricted and receivers had to be redesign-l in order to cope with this condition.

PERFECT IF

Ideally the perfect IF channel would ave a passband of rectangular shape so iat only the intelligence conveyed by a articular type of transmission would be ithin the passband, the steeply sloping des effectively preventing adjacent ations appearing at the detector.

To find out how wide this passband ıould be in our receiver, let us look or a moment at the source of the signal. your voice were to contain com-onents up to, say, 10 Kc, and the trans-ıitter modulation system were "flat" ithin the audio range, the sidebands ould extend 10 Kc above, and 10 Kc elow, the carrier, or a total spectrum ace of 20 Kc.

While this may be quite in order on ie broadcast bands, it is hardly desir-ble on the already crowded shortwave ommunication bands.

Only the voice frequencies between 00 and 3,000 cycles are necessary for ie conveyance of intelligence. This is ot "high fidelity" by any means, but onetheless perfectly understandable. An xcellent example is the ordinary tele-hone which we use in everyday life.

SPEECH FILTERS

A transmitter used only for speech ansmission should contain high and low ass filters to restrict the modulation andwidth below 300 and above 3,000 ycles. Such filters need not be elabor-te. The proper value of resistance and apacity in the audio section will usually ıffice.

Such a transmitter then would occupy total of about 6 Kc of spectrum space. ut this is not the only factor deter-ining the ultimately desired receiver andpass. As we stated earlier, this AM ansmission consists of sidebands above nd below the carrier, and each of these debands contains identical information.

Since they are identical, it would seem easonable to suppose that either one ontains all the intelligence being trans-ıitted. This is, in fact so, and it is ften made good use of in practice.

Given a receiver with a suitable band-pass it is possible to tune it so that only the carrier and one sideband is received, the other sideband being more or less completely suppressed depending on the effectiveness of the receiver bandpass. Although the technique causes minor distortion of the signal, this is often preferable to a strong interfering signal which may appear on one sideband. Either sideband may be selected, according to which ever is suffering least interference.

A logical development of this idea is the true single side band system, in which both transmitter and receiver are designed to handle one side band only. The growing popularity of single side band has inspired the development of narrow passband receivers, but it must be emphasised that this is by no means its only application.

BANDWIDTH REQUIREMENTS

In any case, it would appear that the desirable bandwidth is between 2.5 and 3 Kc. However, there is a good deal more to the problem than this, the "shape" of the response curve being a factor of major importance.

As we mentioned earlier, the ideal bandpass shape is rectangular. This means its response to all signals within a given bandpass, say 3 Kc, would be exactly equal, as indicated by the "flat top" of the rectangle. Similarly, the straight sides indicate that, as soon as we exceed this bandpass, the response drops to zero.

Such a perfect response curve is not likely to be encountered in practice, but we can approach quite close to this ideal. Which brings us, quite naturally, to a consideration of how we may conveniently define a bandpass characteristic without having to draw a precise graph on every occasion.

Two terms are used for this purpose, the "width" and the "shape factor." The width is normally measured between those points which are 6db down on the centre or peak frequency. The "shape factor" is intended to indicate the steepness of the sides beyond this point and is defined as the frequency ratio between the 6db down points and the 60db down points.

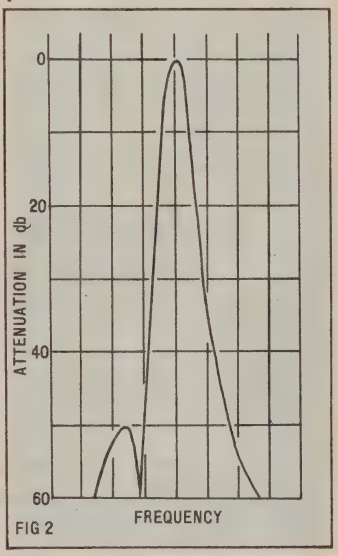

FIG 2

The use of a single crystal with a phasing control will produce an IF response curve similar to the one illustrated here.

Thus, a bandpass characteristic which is twice as wide in frequency at 60db as it is at 6db will have a shape factor of 2 to 1. (A particularly good factor, incidentally.) If it is four times as wide the factor would be 4 to 1, and so on. Fairly obviously, the smaller the ratio, the better the shape factor.

Most communication receivers manufactured today contain a filter capable of

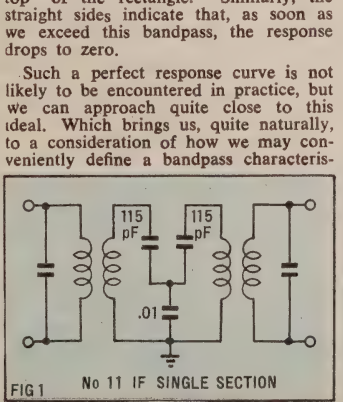

FIG 1 No 11 IF SINGLE SECTION

Typical of the early attempts at selectivity is this system of back to back IF transformers used in the wartime No. 11 receiver.

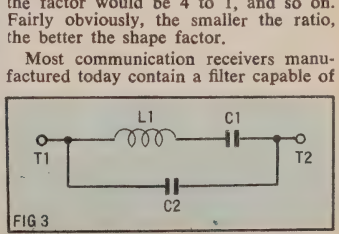

FIG 3

A quartz crystal is electrically equivalent to the above circuit. As can be seen from this it has both series and parallel resonance.

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ing a suitable width and shape factor. is the purpose of this article to mine the capabilities of some of these rs and see how they are constructed. One of the methods used to obtain ie measure of selectivity in earlier mmunication receivers was the use of ck-to-back" IF transformers, either or bottom coupled. The circuit of 1 shows an example of this method, particular one being taken from the time No. 11 receiver.

An interesting feature of this circuit the method used to obtain bottom pling. The 115pF tuning capacitors each circuit are returned to a com- n point and thence to earth through 01 mfd capacitor. The larger this acitor, the less the coupling.

NGLE CRYSTAL

Receivers such as this, while being sidered quite good for their time, are capable of the desired bandpass or pe factor which we need today.

n order to obtain greater degrees of ctivity, IF strips such as the one just cribed were often backed up by a gle crystal and phasing control. The ult is a selectivity curve similar to t shown in Fig. 2. This was of some p in the reception of CW signals, but duced a pronounced "boominess" en used for phone signals, due to the ere attenuation of the sidebands sed by the "peaky" response curve.

Another approach has been the use of multipliers" or "Q 5ers" as they are metimes known. This, however, is ply a method of applying regenera- n to the IF and results in a response ve very similar to the single crystal.

This response curve, as can be seen m the diagram, is a long way from rectangular ideal. While extremely rp within the required passband—it y be only a few hundred cycles wide the 6db points—it tends to spread lly thereafter so that its ability to ect adjacent channel signals is rela- ly poor. In a typical case the shape tor may be as poor as 8 to 1.

The selectivity (or "sharpness") of a ed circuit is proportional to the Q of circuit at resonance. Crystals and multipliers" have a Q factor which metimes rises as high as 10,000.

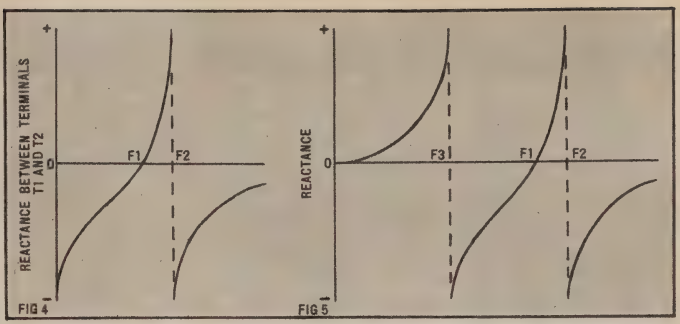
ULTIPLE CRYSTALS

While the sharpness produced by a gle high Q circuit such as a crystal not suited to our purpose, it is pos- e to couple a number of these cir- ts in such a fashion as to produce a e bandpass effect.

The piezo-electric crystal is equivalent the circuit shown in Fig. 3. It can be n from this that it has both series and allel resonance. Fig. 4 is a graph wing the reactance of the equivalent uit for all frequencies between zero l infinity.

A glance at this graph will show that series resonant frequency F1 occurs ere the curve first crosses the centre zero reactance line, and the parallel anti-resonant frequency occurs where ises to a point of high inductive react- e, and then drops sharply through o to a point of high capacitive react- e.

In most crystals these points will ur within a few hundred cycles of h other, and it is with these two onant points (and what we are able do with them) that we are most con- ned.

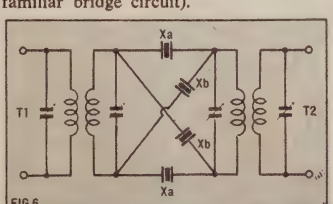


The reactance curves of Fig. 4 show the series and parallel resonance of a single crystal while those in Fig. 5 illustrate the effect of shunting the crystal with an inductance.

If the crystal is connected in circuit with either a series or shunt inductance, the effect will be to spread, as well as to produce, additional resonant frequencies, as shown in fig. 5.

This graph shows the effect of shunting the crystal with an inductance. Now we have the original two resonant points F1 and F2, in addition to a third resonant point created by the shunting effect of the coil, which we shall call F3.

Let us now move to the circuit shown in fig. 6 which shows two pairs of identical crystals connected in a single section full lattice filter (the word "lattice" incidentally is only another name for the familiar bridge circuit).



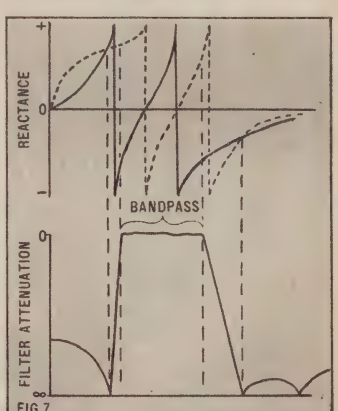
The circuit above is that of a typical single section full lattice filter. The crystals marked "Xa" and "Xb" are identically matched pairs.

In this circuit the two transformers T1 and T2, which are standard IF transformers, perform the dual service of impedance matching into and out of the network, as well as forming the shunt inductance previously mentioned.

The graphs shown in fig. 7 illustrate the reactance-versus-frequency characteristic for this configuration. From this we can see that we have points of high attenuation where the reactance values are equal and of the same sign, i.e. either plus or minus, and a bandpass effect for those frequencies where the reactances of the two filter arms are opposite in sign.

This bandpass effect is achieved by the operating characteristic of the bridge circuit, and is brought about in the following manner: when the reactances of the bridge arms are equal and of the same sign, signals transmitted through the two possible paths of the bridge will cancel each other, producing points of high attenuation.

However, when the reactances are of opposite sign, signals will be transmitted through the network, the maximum signals being transmitted at the points where the reactances are equal in amplitude and opposite in sign. The small troughs in the passband between these points of maximum transmission are only in the order of a few db in a well designed filter, and would in no way

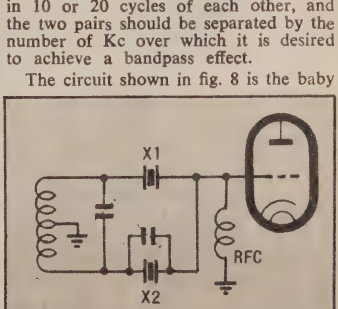


Shown above is the reactance curves versus bandpass effect of the full lattice filter shown in Fig. 6.

effect the performance of the unit as a whole.

In order to achieve the maximum benefit from such a filter as this, each matched pair of crystals should be within 10 or 20 cycles of each other, and the two pairs should be separated by the number of Kc over which it is desired to achieve a bandpass effect.

The circuit shown in fig. 8 is the baby



Using only two crystals the above circuit is known as a "half lattice filter" and is popular where available space is at a premium.

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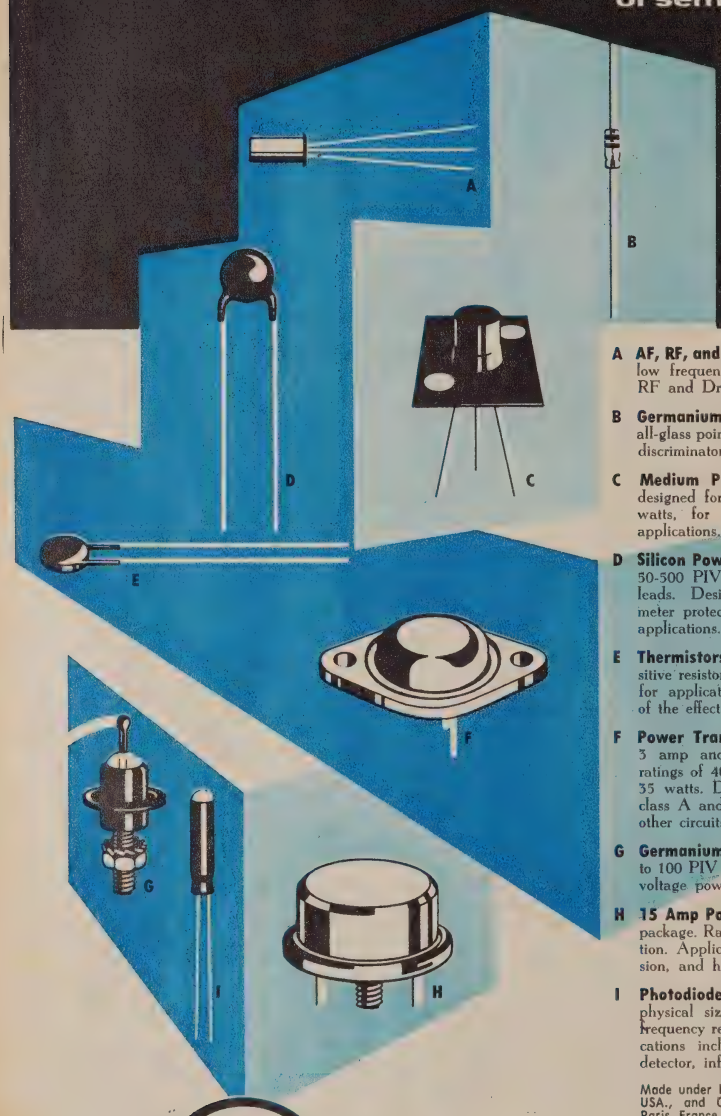

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rother of the full lattice filter and be-
ause it uses only two crystals is known
s a "half lattice filter." In this circuit
ie phasing capacitor of the familiar
ngle crystal filter has been shunted by
second crystal X2 which is separated
y the desired passband from the crystal
1.

With this arrangement the skirt-width
ill be twice as wide at the 60db down
oint as when using the full lattice con-
guration.

Lattice filters such as these can be con-
ructed on almost any frequency for
hich suitable crystals are available,
me commercial units being made as
igh as 9 Mc with a claimed skirt factor
f 2 to 1.

Another approach is the use of mul-
ple tuned circuits. Recent years have
en the introduction of some excellent
eramic materials, popularly known as
ferrites," which make possible tuned
ircuits having a Q of up to 500, and
ossibly more. While this may seem
mall when compared to a crystal, a
umber of such circuits in cascade will
roduce a quite acceptable filter.

TYPICAL CIRCUIT

Fig. 9 shows the circuit of such a
lter. Designed to have a centre fre-
uency of 60 Kc this particular filter
orms the heart of a well-known Ameri-
an communications receiver especially
anufactured for single sideband recep-
on.

Top coupling is used here, the value
f coupling capacitors being chosen to
vercouple the circuits and so produce
ie desired bandpass effect.

Yet another filter of this type is shown
n fig. 10. This has a centre frequency
f 85 Kc and consists of five parallel-
ned circuits with four top coupling
apacitors and two resistance termina-
ons, the end inductors having twice the
nductance of the three inner ones.

The four position switch enables band-
idths of 750 cycles, 1.8 Kc, 3.9 Kc and
.5 Kc to be selected. The shape factor
aries from 4.4 to 1 to as low as 2.7
o 1.

While it is possible to obtain good
andpass characteristics with both crys-
als and multiple high "Q" tuned circuits,
here are disadvantages in both arrange-
ents. In the case of crystal filter it
equires at least two full lattice filter
ections in order to obtain a shape factor
pproaching two to one. This is a bulky
nd expensive business.

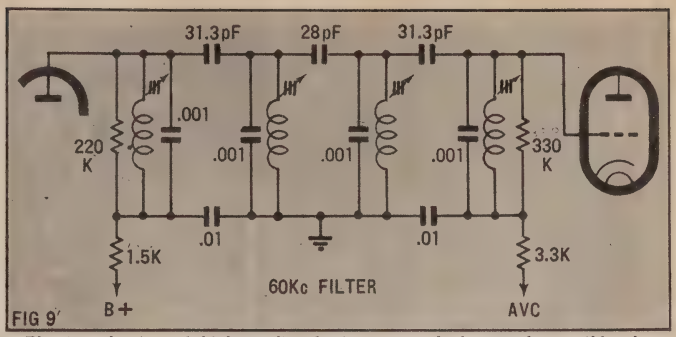


FIG 9

The introduction of high quality ferrite materials has made possible the design of some excellent filters consisting of cascaded high Q tuned circuits. The circuit above is taken from a receiver especially designed for single sideband reception.

Similarly, the multiple tuned circuit has its limitations. A good shape factor is only possible at relatively low frequencies and it also is fairly bulky. However, it has the advantage of being economical to construct using readily available components.

By far the simplest to install and most efficient of all filters is the type known as the "mechanical filter." These devices make use of the high "Q" inherent in the mechanical resonance of metallic bodies. They can be superior to the best electrical circuits by up to a hundred times.

MECHANICAL FILTER

The mechanical filter consists of a number of resonant metal discs centred between an input and an output transducer. These transducers serve merely as mechanical to electrical and electrical to mechanical coupling devices and will have no effect on the selectivity of the metal discs provided they are correctly resonated at the operating frequency.

When an electrical signal is applied to the input transducer, it is converted into mechanical vibration by means of magnetostriction. This mechanical vibration travels through the resonant metal discs to the output transducer where it is once again, by means of magnetostriction, converted into an electrical signal.

Each of the metal discs contained in the filter is resonant at a separate frequency within the desired bandpass range of the filter and the overall effect is to produce a response similar to that

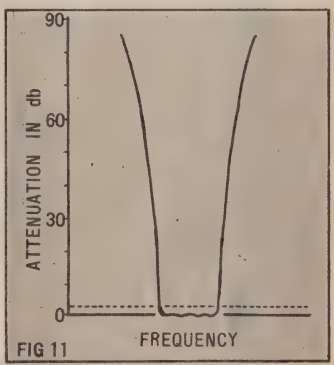


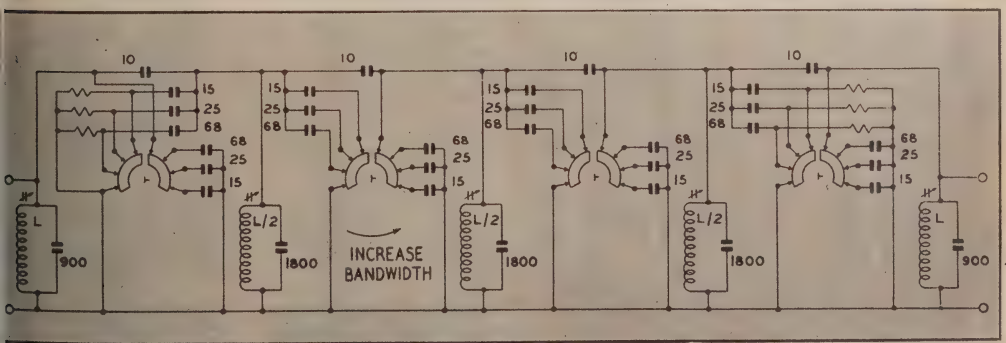
FIG 11

By far the best filter of all is the mechanical type. The graph above shows the excellent bandpass characteristics and shape factor of a typical unit of this type.

shown in fig. 11. From this it can be seen that the skirt or shape factor is less than 2, this being better than two sections of full lattice filters.

The photograph on Page 109 shows a type of mechanical filter for use in FM mobile equipment and gives some idea of the small size of these units. This particular filter has a bandwidth of plus or minus 18 Kc from its centre frequency of 473 Kc and a shape factor

(Continued on Page 109)



The filter circuit shown above is similar in principle to that of Fig. 9 but has the advantage of variable selectivity. Designed to have a centre frequency of 85Kc its "shape factor" varies from 4.4 to 1 in the narrow position to 2.7 to 1 in the broad position.

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£7/10/- Each

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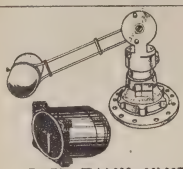

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Contains sender and receiver units. Used in place of Selsens as direction indicators.

15/- Pair

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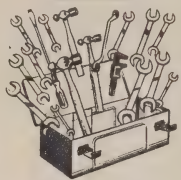

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1 Ring Spanner, 5/8in x 11/16in.
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1 6in Shifting Spanner.
3 BALL PEIN Hammers — 8oz, 16oz, 24oz.
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1 15ft tow-rope with spliced loop and steel hook.
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INPUT. A.C.V. 240, 230, 220, 210, 200v. Also 100, 110, 120, 130v. OUTPUT D.C.V. 24v D.C. Tapped to give 2at 12v D.C., 3 amps output. Voltage output can be increased in small steps to 28v D.C.

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Small Erecting Prism .... £1 ea.
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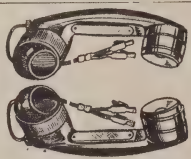

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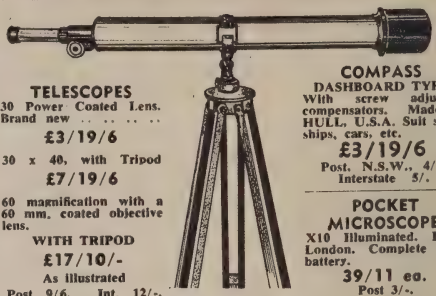

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30 x 40, with Tripod

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60 magnification with a 60 mm. coated objective lens.

WITH TRIPOD

£17/10/-

As illustrated

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X10 Illuminated. Beck, London. Complete with battery.

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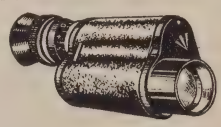

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1 3/8in diam., ¼in shaft, 30/ doz.
1¾in diam., ¼in shaft, 42/ doz.
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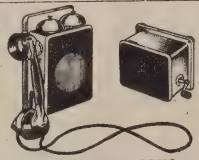
3½in diam., 3/8in shaft, 66/ doz.

Add postage.



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RT24/APX2 or B/APX1 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

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ALSO HAS A STEPDOWN TRANSFORMER 240 V.A.C. 100-115 V.A.C. AT 5.33 AMPS.

The unit has three outlets for A.C., two outlets for D.C., and will operate all voltages input around 240 V.A.C. and 110 V.A.C. has many input tappings, also has 110V rectifier choke and two 500 M.S.D. capacitors. Stepdown transformer 240V to 110V A.C. £10 or

Complete Unit £12/10/

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COMPLETE TRANSMITTER NO. 153

A.W.A. type J51050 comprising R.F. unit, power control and minor rectifier unit and main rectifier unit, with spares. 100 watt R.T. 300 watt C.W. Crystal controlled 2 to 20 megs, with power supply. 110 or 240 volt A.C. 50 cycle. New. Will transmit over 500-mile range daytime. World range night. Original cost £2,000. Heavy-duty wide band aerial included.

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Contain these lenses:
1 lens 1in Focus, ½in diam.
1 Lens 1 11/16in Focus, 1¼in dia.
1 Air Spaced Lens, 1¼in diam.
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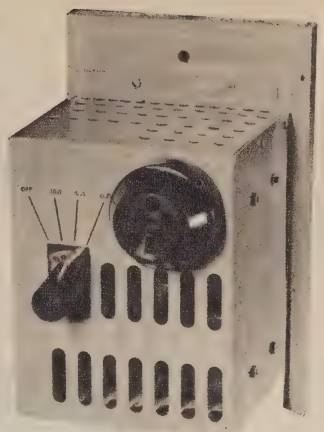
ROJECTION LAMP PRE-HEAT UNIT MADE FROM ODDMENT PARTS

his simple gadget which, in the first instance, was built for next to othing, looks like saving many pounds, apart from being very nvenient in use. What is it? An "Off-Preheat-On" control for a high-powered projector lamp.



OST people who operate projectors are familiar with the lamp switch-roblem but not all have taken steps neet it.

brief, the lamps used in projectors nally start, in terms of wattage, re domestic electric light globes e off, and run up to 1,000 or even 0 watts. In addition, they are nor-ly designed to operate at a very high ent temperature, in order to ensure dequate output of "white" light.

he most hazardous moments in the of a projection lamp are those mo-ts when the switch is closed and the ating voltage is applied to the cold ent.

ARTING SURGE

these circumstances, the resistance he filament is very much lower than resistance at operating temperature , for a brief instant, an extremely current flows. There is always a ger of this excessive current ruptur-the filament or, at least, causing age which will shorten the useful of the lamp.

uch is the cost of projector lamps anything which can be done to ce such risk is well worthwhile.

many cases, notably in equipments g 110-volt lamps from 240-volt ns, the protection is gained more or as a matter of course.

/here a voltage dropping resistor is l, the very presence of the resistor ensure that the switch-on surge will exceed more than about twice the nal operating current. This is ample ection.

ven where a transformer is used, e is a good chance that resistance, age reactance and saturation effects provide sufficient short-term protec-

hen again, a few projectors have t-in pre-heat switches.

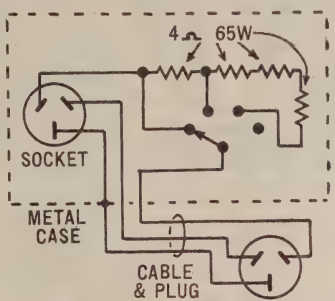
ORST CASE

he main problem occurs with 240- lamps, operating directly from the er mains and with only the resis-e of the mains and of the lamp itself imit current.

ome years ago (October, 1958, p. 95) drew attention to the possibility of ig thermistors in conjunction with ps up to 500-watt rating. These are ial temperature-sensitive resistors ch have a relatively high value when l, but which rapidly assume a low e when hot. (They are distributed Australia by S.T.C. and sold through e radio supply houses.)

Connected in series with a projector p, a thermistor will effectively absorb reduce the switch-on surge, there-after introducing only a small, though permanent voltage drop.

Unfortunately, suitable thermistors are not available as yet for ratings above 500 watts, which therefore still leaves with his problem the person who wishes to operate a projector involving a 750 or 1,000 watt lamp at 240 volts. While such lamps are not commonly encountered in projectors for domestic use, they are used in movie projectors and in still projectors of the more ambitious variety, as might be employed, for example, in churches and clubs.



A check on a resistance bridge indicated that the cold resistance of a 240-volt 1,000-watt lamp is a mere 4 ohms. Connect this across the 240-volt mains in a well-regulated supply area, and the current at switch-on is 60 amps!

Having lost three high-powered lamps in quick succession, the author decided that the risk was not good enough and began to search through his junk box.

RESISTORS

What came to light first was a number of 4-ohm heavy duty resistors, rated at 65 watts apiece, and stripped originally from a disposals power-supply and regulator unit. We remember having seen lots of these on bargain counters for a few pence each, for the obvious reason that nobody could think of anything much to do with 4-ohm 65-watt resistors!

A quick calculation showed that four such resistors introduced in series with the lamp at switch on would drop the surge current to 12 amps, which is less than three times the operating current —not 15 times! Furthermore, with a rating of 65 watts, they could carry the lamp current for longer periods without exceeding ratings.

The next step was a switch and, while it would have been possible to use one of the new heavy-duty wafer types, a further search brought to light an "Admiralty pattern" stud and wiper switch, complete with clicker plate that had probably been used as an aerial or transmitter tank switch. However, there was no doubt either of its insulation qualities or its ability to carry the current.

Last but not least came a metal cover of quite unknown origin but sporting plenty of holes for ventilation. It happened to measure 4¾ inches wide by 6¼ high by 4 deep.

It was a relatively simple job to mount the resistors and the switch (with due respect to insulation requirements) inside the cover and wire them to give the following positions: (1) Off; (2) 16 ohms in circuit; (3) 4 ohms in circuit; (4) Full on.

OPERATION

The whole assembly was then screwed to a wooden baseboard and this attached to the wall adjacent to the projector position. It now serves as an off-on switch but with a difference. You can't switch the projector on without passing through the pre-heat positions.

As arranged, the projector is simply plugged into the unit and thence into the power mains, so that the voltage is dropped both to the blower fan and the lamp. Perhaps this is the lazyman's way but it's the easy way and perfectly effective for the required purpose.

It's a very comforting feeling to click the switch slowly through its positions and see the lamp come up slowly—and stay on!

Incidentally, the four-position switch is something of a luxury, though it is practical to operate the lamp for lengthy periods through one resistor, giving a permanent 8 volts of drop.

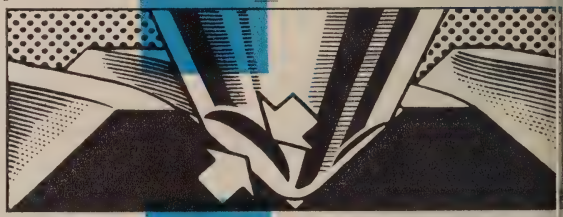
A subsequent check through disposals items revealed a number of 15 to 20 ohm resistors of 150 watts or more rating, one of which would have served equally well as a surge limiting resistor.

For 750-watt globes, slightly higher resistance values would be appropriate, possibly at somewhat lower wattage ratings. In fact, for any given wattage a good guide would seem to be to measure the cold resistance of the lamp, then arrange to preheat it through series resistance equal to about four times this value, thus limiting the surge current to one-fifth of what it would be without protection.

Are your playing hours wearing out?

The smooth, perfectly rounded B.M.B. needle rides the record grooves evenly. When the needle no longer looks like this, the sound is not hi-fi.

The so-called "permanent" needles sold with modern record reproduction equipment will wear out, contrary to the usual belief. These needles actually have an effective playing life of approximately 40 playing hours . . . then the smooth radius starts to wear, the needle sinks lower in the record groove, the delicate sound track is chiselled away.



This worn needle rides lower in the groove than a good needle and plan off sound with every playing.

The B.M.B. range of sapphire styli includes over 30 different types—most available with diamond point, and interchangeable with other brands.

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MSA17

Let's Buy An Argument

A reader from Auckland, New Zealand, has come forward with some interesting remarks about the formation of "negative" television ghosts. He states that he has seen the phenomenon many times in England and says that the explanation is really very simple.

By Neville Williams

BEFORE actually proceeding to the explanation, he takes me to task ather severely for the tone of my reply o our original correspondent from Ade- iide, considering that the levity was in omewhat bad taste. A serious question, e maintains, warrants a serious answer. He could be right, of course.

It is most embarrassing, when you 'y to be funny, and only half the audi- nce laughs.

It is even more embarrassing if no ne laughs!

DISCUSSION INVITED

I can only assure our correspondent hat I had no intention of ridiculing the riginal writer. Apart from the levity 'hich, I am afraid was quite spontane- us, the intention rather was to leave ie way open for the very kind of dis- ussion which keeps these columns alive.

I rather gather that our present cor- espondent's feelings were heightened, in arge degree, by an assumption that I ad denied the existence of negative hosts—something which he had seen 'ith his own two eyes.

In fact, I did no such thing. Rather id I query whether the effect was unduly prevalent in Adelaide (col. 1), and, on this point, comment was invited.

Then, after the phrase, "seriously though" (intended to terminate any thought of levity) I quoted a textbook reference to negative ghosts, which is actually a too-brief summation of what our correspondent subsequently has to say.

And what has he to say? Well, I quote:

"A typical example of negative TV ghosts often occurred during the transmission of the B.B.C.'s test pattern when aircraft were flying in the line of sight to the transmitter. A strong ghost would appear, changing from positive to negative and back to positive every second or so.

"Before I go any further, I will forestall a possible comment regarding the fact that the British television system has positive-going picture modulation, whereas Australian TV has negative-going. Negative ghosts are equally possible with either system, and I will base the explanation which follows on the Australian.

"A.F. states that the effect is most noticeable with lettering on a plain background and that is to be expected.

"Suppose the background to be grey (about 45pc. carrier from the transmitter) and the lettering to be black (75pc. carrier from the transmitter).

"Now imagine reflection from some object which, at a given instant, results in an out-of-phase signal at the receiver, considerably weaker than the direct signal.

EQUAL AND OPPOSITE

"The grey background will be somewhat lightened by the reflected out-of-phase signal, but not very noticeably. However, the reflection of the original lettering (75pc. carrier) displaced and attenuated by the path difference, could easily arrive at about the strength of the existing background, or equivalent to 45 pc. carrier.

"Being out of phase, it will completely cancel the background at the point at which it appears, causing that bit of background to correspond to zero carrier or peak white. Hence we have, as well as the original black lettering, displaced white lettering, or, in other words, a negative ghost.

"Black ghosts of white letters or objects could be caused by in-phase reflections (in this case preferably stronger than the direct signal), being superimposed on a grey background and darkening it at that point.

"The in-phase echo of a white object (15pc. carrier), particularly if stronger than the direct signal, boosts the effective carrier and causes a dark or even black image on that part of the background.

"In practice, several echoes are often present in an area of bad reception, some weaker and some quite easily stronger than the direct wave. In the case I mentioned at the beginning of the letter, reflection from an aircraft in a fairly low signal area can give a reflection which varies second by second, in both strength and phase, as the aircraft flies along the signal path.

POSITIVE AND NEGATIVE

"This gives rise to positive and negative ghosts, varying all the time. I hope that A.F. will be satisfied by this explanation, and I can assure him that negative ghosts are very real, and that they appeared on British television twenty years before being seen in Adelaide.

"I should mention that a fairly uniform grey background at about half carrier level is necessary for really good negative ghosts. The B.B.C. test pattern

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Designed to provide background music of any desired type. Consists of tape-transport mechanism, 5-watt transistorised amplifier, a monitor speaker, and a necessary socket for connecting external speakers and accessories. A range of models to suit all requirements, featuring the **automatic tape magazine.**

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GENERAL ELECTRIC'S STEREO MAGNETIC VARIABLE RELUCTANCE CARTRIDGES

The VR-22's are outstanding in all four areas of stereo cartridge performance! Response from 20 to 20,000 cycles (VR225), or 20 to 17,000 cycles (VR227). High consistent channel separation—up to 28 DB. New stylus assembly for optimum compliance! New triple shielding for positive hum suppression. VR225—£25/16/. VR227—£23/5/6. Also mono cartridges, styli and pick up arms.

THORENS

FROM SWITZERLAND! STEREO TURNTABLES BY THORENS.

Mirror finished, precision machining—and you save with an in-built tone arm that has tracking ability and distortion characteristics to equal more costly separate arms. TD184L with semi-automatic operation—£56/5/. TD124 "Matchless" transcription model—£79/8/6 (without tone arm). TD134L—£46/17/6 (tone arm without cartridge).

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PHONE BX6731 — Audio Engineers PTY. LTD. — 422 KENT STREET, SYDNEY

has such a background and most na tive ghosts I have seen have been ir ing test pattern transmissions.

"Yours faithfully, F.K."
(Auckland, N.Z

Well, thank you, F.K., for your n tribution.

The first part of the letter is ca sailing and states clearly and at sn length what occupies only a few wo in the textbook reference referred to ar lier.

In the second part of the letter, th seem to get out of hand for our co respondent apparently has in-phase ar rier signals producing a negative gos effect.

IS IT VALID?

This reasoning is highly suspect.

To be sure, any in-phase signal wi accentuate the direct signal, so that en a "white" signal will make the co sponding area darker. But the adjac "non-white" signals will equally ta the adjacent areas darker still, so ta no optical tone reversal will occur.

All that will happen is that a wo positive image will appear, displace in time, and thereby producing a posi ve ghost.

It seems to me that, to make anyth else of this, one would have to in duce possibilities of overload and co sequent tone reversal, to which our co respondent makes no reference.

So much, then, for negative ghos wonder if this is to be the last wor

In completely different vein is the et ter opposite, regarding radio clubs in schools. I suggest you read it at his juncture, in order that the followin re marks will make sense.

Read it? Good!

There is no reason for me to dis issue with the writer, but I think tha a few general observations would b in order. If these, in turn, stir some ody else to express themselves on the ub ject, there should be plenty of spac available for same in future issues.

First and foremost, "Radio, Televisio and Hobbies" does not subscribe to th idea that radio clubs "must be ru by Licensed Amateurs" and "be limite to interesting youth in Amateur Radio.

On the contrary, any activity whi fosters an interest in electronics can onl increase the potential number of ou readers. Some of our simpler projects, for example, the transistor set in his issue, are deliberately aimed at beginners — not at those who are immediate po tential amateurs.

"AMATEUR BANDS" REFEREN E

It so happens that editorial refere ce to individual club activities is la ely limited to what appears from tim to time in the "Amateur Band" pages.

These pages are set aside for spe ific news of amateur activities, because Li censed Amateurs form an impo ant sector of our readers. Our corresp nd ent, who is an independent contrib or, not a staff member, elects to include tub notes from time to time only bec se he considers that they are of suffi ien interest to the amateurs for whom he writes.

To throw open separate space for notes about individual and unrela ed small radio clubs would involve pp ping other material to which, at th

RE RADIO CLUBS IN SCHOOLS

Dear Sir,

The "Amateur Bands With Bill Moore," Jan., 61, and previous references to Radio Clubs in Schools have been very interesting; but why must the clubs be run by Licensed Amateurs and feature only in the Short Wave section of "R., TV & H"; Also why must they be limited to interesting youth in Amateur Radio and not electronics generally?

In Melbourne recently a newspaper featured a group of matriculation girls operating a short wave station. This is certainly very commendable but does it necessarily indicate knowledge of theory or ability to build?

Not every school staff has a licensed amateur, so, as a science teacher, I run a radio club and place emphasis on theory and practice in many branches of electronics.

Last year the Form I boys (11-plus years old) became enthusiastic about and built many C.R.O. circuits and towards the end of the year were inquiring about "electronic brains" and binary digital computers.

Many of the young pupils design their own radio, oscillator and test circuits, etc. We use a graded "Radio Builder's Certificate" which I drew up to act as a syllabus guide and to record each member's progress. At the year's end the headmaster distributed the certificates publicly.

If any others are interested in suitable circuits for grade 5 onwards, my pupils and myself will be pleased to co-operate.

If the W.I.A. organises School Radio Clubs, does it mean that clubs like mine should cease this sort of operation while the organiser gets a licence and teaches the members to speak into a microphone and tap a morse key?

Yours faithfully,

Bruce R. Fisher, Science Master, Camberwell Grammar School.

moment, we feel compelled to give precedence.

In the general scheme of things, Amateurs gain an advantage because they have affiliated, mainly through the Wireless Institute of Australia, enough to speak with one voice, and to work to common ends. They have been able to organise large-scale rallies, and well attended technical meetings; they have set up emergency networks and made their voice heard in Parliament, and, overseas, at the recent Geneva Conference.

Rather than decry their efforts, I think we should applaud. After all, they are fostering interest in at least one branch of electronics, usually with a fair degree of penetration into others.

The real problem of those interested only in other branches of electronics is to establish and maintain co-operation with others having like interest and to emulate the amateurs in their self-propagation.

DIFFICULT PROBLEM

Unfortunately, this is by no means easy to do, particularly where schoolboys are involved, with their rapidly changing interests. A mere interest in electronics is not nearly as specific as the urge which some have to establish their own radio station and, having done so, to assist others to do likewise.

In the face of school radio clubs organised by the W.I.A., our correspondent asks whether he should cease his present operations until he can teach club members to "speak into a microphone and tap a morse key."

But why?

One might as easily reason the same way about a club formed, say, around a common interest in the radio control of models!

In the meantime, publication of our correspondent's name and address may serve to put him in touch with others having a common interest in "non-amateur" radio clubs.

By way of conclusion, I have a letter from a Victorian reader who says: "I have read about a television aerial having gain. How can an aerial have gain? Where does it come from?"

A good question.

Perhaps the terminology is most easily understood by thinking first in terms of a VHF transmitting aerial, as used by so many radio amateurs. A simple half-wave dipole is regarded as being a standard or "reference" aerial.

Let's imagine that an amateur radiates a signal from a simple dipole and that the signal has a certain measurable strength at a given distant location.

The amateur now adds a reflector or director element, or both, to the dipole and discovers that his signal at the distant location is much stronger. He may observe that the aerial has given him a "gain" of say 6db.

In fact, the aerial has not increased his total radiated power but it has concentrated it in the direction in which he wishes to communicate. The greater the concentration in both the horizontal and the vertical plane, the greater will be the effective gain.

REVERSE ACTION

The situation is reversible. A dipole receiving aerial will pick up signals of a certain strength from a given remote transmitter. More signal can be picked up from the said transmitter if elements are added to make the aerial specially sensitive to signals arriving from that direction. Relatively speaking, the aerial can be considered as having a certain amount of gain.

A close analogy can be found in the manner in which optical reflectors can increase the amount of light radiated in or collected from a certain direction.

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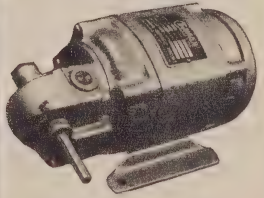

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TRADE REVIEWS AND RELEASES

HIGH VALUE PAPER CAPACITORS

A new range of metallised paper capacitors has recently been announced by Australian Engineering Equipment Pty. Ltd. Representing something quite new in high value capacitors, they should find immediate application throughout industry.

RANGING from 2 to 20 mfd with working voltages from 150 to 350, hey are intended to satisfy the frequent eed for high values of capacitance with- ut the electrical limitations of electro- ytics, or the bulk and cost of conven- ional paper types.

By using the metallised paper prin- iple, the manufacturers have been able o produce an 8 mfd, 150 volt type in can only 3in long by 1 3/8in dia- neter—only a little larger than a com- arable electrolytic type. This type, long with 2 mfd, 150 volt units, is hown in the accompanying photograph.

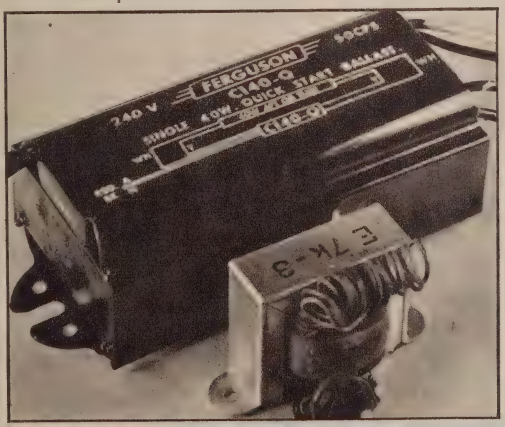
The makers state that these new units ave been designed for applications here high capacitance values with small imensions are required, and where sta- ility of capacitance with temperature ariation, low leakage, reversibility, and long life are essentials. It is claimed that performance is equal to normal foil and paper types.

While many applications will suggest themselves, one that comes immediately to mind is the loudspeaker cross-over network, where large values of capacitance have always presented a problem.

Further details, specification sheets, price, etc., may be obtained from the N.S.W. agents, Wm. J. McLellan and Co., Pty., 126 Sussex Street, Sydney.

TWO NEW ITEMS FROM FERGUSON

Pictured here are two recent releases by Ferguson Transformers Pty. Ltd., of 441 Victoria Avenue, Chatswood, N.S.W. One is a ballast inductor intended for use with 40 watt fluorescent tubes of the quick-start type, and the other a sample from a new range of small single-ended speaker transformers.



THE ballast inductor, designated as type C140-Q, is intended especially for 40 watt quick-start tubes, but may be used with normal types, where the tube is physically close to the earthed metal fixture. It is impregnated, and has the normal mounting provisions.

The speaker transformer, type E7K-3 is one of a series of three types having the same nominal secondary impedance of 3 ohms, but primary impedances of 5,000, 7,000 and 10,000 ohms respectively. As the name suggests, this model is the type with the 7,000 ohm primary. The other types are designated E5K-3 and E10K-3 respectively.

Inquiries regarding the price of the fluorescent ballast should be directed to the manufacturers. Price of the speaker transformers is quoted at 21/9 including tax—retail. (J.R.).

FREE DATA FROM DUCON

DUCON CONDENSER PTY. LTD., announce that they have available a large selection of pamphlets covering all of the many phases of their activities. These are comprehensive technical data sheets which contain all the electrical and physical specifications likely to be needed by design engineers, amateurs, experimenters, etc.

Components currently produced by this organisation include capacitors in a very large range—electrolytic, paper, mica, ceramic, plastic film, etc., from tiny radio types to large transmission types used for power factor correction and similar applications.

Other products include ceramics, semiconductors, and potentiometers, the latter including multiple units, switch combinations, and ultra miniature types for transistor radios. There is also a wide range of resistors, wire wound and carbon in all normal values and tolerances.

These pamphlets are available free on request, which should be sent direct to the company, at Box 2, Post Office, Villawood, N.S.W. It is suggested that they specify the subjects of interest. If desired, it may also be requested that the sender's name be added to a mailing list for further issues as they become available.

LABCRAFT 573V RECORD PLAYER

MESSRS G.R.D. INSTRUMENTS PTY. LTD., advise that the popular "Labcraft" 573V turntable, which they are marketing, is now available in a smart satin-grey finish, with turntable mat and arm in black.

In addition, all turntables are fitted with a "velvet action" arm lifting and lowering device, at no extra charge.

To facilitate the fitting of different cartridges into the 573V head shell, G.R.D. Instruments are making available an adaptor plate and assorted nuts, screws and washers, together with a diagram showing head shell connections. From a sample supplied for our inspection, it appeared that most heads could be accommodated. (6 Railway Walk, Camberwell, Victoria.)

FERRIS

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TECHNICAL BOOK REVIEW

REPAIRING TRANSISTOR RADIOS, by S. Libes. Soft cover, 168 pages, 5¼in by 8¼in. Published by John F. Rider, Inc., New York.

The author of this book has, for many years, been writing articles relating to the repair of electronic devices, for publication in magazines catering to professional repair technicians. He is thus well qualified to write a book of tnis nature.

Chapter one is entitled simply "The Transistor" and consists of a nicely condensed, clear and concise picture of how a transistor really works.

Following chapters cover the various sections of typical transistor receiver circuitry stage by stage in a practical, and easy to follow manner, in which both the beginner and the experienced technician will find solutions to elusive problems and faster trouble-shooting procedures clearly described.

A transistor interchangeability chart is given covering the majority of types in use.

The book concludes with a chapter on all-transistor and hybrid car radios and suggestions as to the type of tools and test equipment necessary to this relatively new but growing facet of the art.

Our copy came direct from the publisher, John F. Rider, Inc., of New York, but copies should be available on the local market in due course. No Australian price has been given.

★ ★ ★

PRACTICAL AUTO RADIO SERVICE AND INSTALLATION, by Jack Greenfield. Soft cover, 5½in x 8½in, 160 pages. Gernsback Library Book No. 87. Contains circuits, photographs and diagrams.

The author of this book has been guided by the thought of the practising radio and television serviceman who desires to widen his field of interest to include car radio servicing. With this in view, every effort seems to have been made to provide as much specialised servicing information as possible.

An individualised approach is used in the arrangement of the material. The text first covers the car radio servicing field in general, including design features, setting up shop and types of sets encountered. This is followed, in chapters three and four, by a survey treatment of installation techniques and speaker arrangements. A chapter is devoted to trouble shooting and repair, and includes a number of complete receiver circuits.

Theory on tuners and power supplies, including various types of DC to DC converters, is given as supplementary information. The chapter on interference suppression gives a clear outline of ignition interference, trouble shooting and suppression techniques.

Finally, the last chapter contains a discussion of present developments, and some possible trends of the future.

Our copy direct from the publishers. Supplies should be available from leading booksellers in the near future. (J.D.)

★ ★ ★

VHF LINE TECHNIQUES, by C. S. Gledhill, published by Edward Arnold Ltd., London. Hard cover, 60 pages, 8¼in x 5¼in.

Written primarily for engineers and advanced students, this book deals in detail with transmission line problems peculiar to VHF operation. Advanced mathematics is used freely throughout the text but the aim of the book is to show how much of the tedious calculations involved can be eliminated or considerably speeded up by use of the circle-diagram, or Smith chart.

Although only five chapters in length, sufficient information is given to make the book of real practical value to those dealing with transmission line design and operation.

The first chapter introduces the Smith chart and explains its uses and how it may be employed in network design. The following chapters cover single frequency and broad band matching techniques as well as transmission line transformer design.

The final chapter concerns various measurements and calculations involved in the operation of such lines.

Definitely not for the beginner, the book is a fine source of information for those whose work involves VHF transmission line design.

The price is 23/6, plus 1/ postage. Our particular copy came from the Technical Book and Magazine Co. Pty. Ltd., 295-299 Swanston Street, Melbourne, C.1. (K.J.)

★ ★ ★

SEMI-CONDUCTORS, by Dr R. A. Smith. Hard cover, 6¼ x 9¼in, 494 pages, with prolific diagrams and circuits. Published by the Cambridge University Press.

The author of this book is the head of the Physics Department of the Royal Radar Establishment, Malvern. As this might suggest, the book is not intended for beginners to electronics, but rather for people with a good background in Maths., Physics, and Engineering.

This is not to suggest that the book deals only with advanced work concerning semi-conductors. Rather, the author has prepared a very extensive work on the fundamentals of the subject. Thus it would form a very good starting point in getting to know the basic principles of semi-conductor theory.

There are chapters on properties of the crystal lattice, energy levels, electron transit phenomena, thermal and optical effects and diffusion. He then deals with empirical measurements on semi-conductors, and features of element and compound semi-conductors. A final chapter is devoted to a review of current applications for many types of semi-conductor devices.

Written in a very clear and comprehensive manner, making it very suitable for learning or reference alike, the book would be a good choice for the engineering bookshelf. The standard is such that it should also prove most suitable for final-year students in Physics and Electrical Engineering. While possibly a little deep in spots for folk with less extensive training, it will usually answer the common, "What's the real story?" questions which crop up in most laboratories and workshops.

Price of the book is 93/6, and it is currently available from local bookstores. (J.R.)

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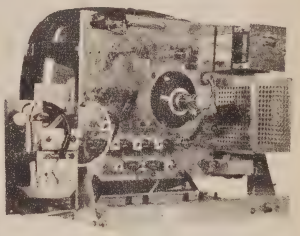

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3S4	10/	1L5	9/6	6J7G	5/	12A6	5/
1R5	10/6	1Q5G	2/6	6C9G	5/	EF50	2/6
1A7GT	9/6	1P5G	2/6	6S57	8/6	12SH7	5/
1D8GT	9/6	1C7G	3/	6H6	2/6	6K7G	4/6
6K8G	6/9					1C6	7/6
6SJ7GT	9/6					955	2/6
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ITTING NEW P.U. CARTRIDGES, ETC.

Over the past few months, I have found myself, many times, up against a problem which has doubtless confronted other enthusiasts —the problem of mating a pickup or cartridge which you fancy or can afford, with an arm and/or a motor which you likewise fancy or can afford. Sometimes it's like the famous 22 over 7 . . . . . it won't go!

By Neville Williams

RECALL the laments of a reader over this very problem, some years o, and his suggestion that we should blish instructions regarding the com- ation of various cartridges, arms and tors. He stressed that we be careful draw attention to the ones that ren't a proposition.

Fairly obviously, he had forgotten tool-time lessons about permutations d combinations and the huge numbers ich can result therefrom. Had we d to follow his suggestion, we would I have been valiantly screwing things ether and takings things apart, trying keep up!

SEFUL POINTS

No, I have no intention of embarking a recitation of what will and won't . But I can make a few points which y alert readers to the likely problems, her than have them learn about the d problems the hard way.

Let's begin by remarking that you can yourself a pickup/motor combination various ways but notably:

(1) By buying a composite playing k, ready to screw into a cabinet.

(2) By buying a separate motor and a plete separate pickup and putting m together.

(3) By acquiring cartridge, arm and tor all separately.

To buy a complete playing deck, as in (1), is superficially a fairly safe and simple procedure, because it can reasonably be assumed that the components will be compatible.

But the matter doesn't always rest there and the owner may ultimately find himself involved in modifications, seeking improved results. Let me quote to actual examples to illustrate what I mean, both known to me personally.

Example number 1 was a complete motor/pickup combination fitted with a fairly early model magnetic stereo cartridge. Because of limited compliance and other undesirable characteristics, the cartridge was clearly outclassed by later designs, though the motor itself was reasonably good.

Problem: Could a new and different cartridge be fitted satisfactorily to the existing arm or would the whole arm, including the auto stop mechanism, have to be sacrificed, and a new arm fitted on to the metal baseplate?

Example number 2 was a complete unit, with crystal cartridge, excellent in all respects but limited to the performance of a turnover crystal.

Problem: Could a magnetic cartridge be fitted in place of the crystal or would a whole new arm have to be installed, as above?

The purchase of a separate motor and pickup (situation 2) usually involves the deliberate choice of particular high quality components and should be a safe procedure.

It isn't entirely so, because some pickup cartridges, sensitive to stray magnetic fields, can pick up hum from an unsuitably placed drive motor. And, in respect to the pickup, there are questions of service facilities, stylus replacement and the availability of interchangeable heads, should these be deemed necessary.

GREATEST HAZARD

Lastly, situation 3, the combination of entirely separate motor, arm and cartridge allows for the greatest flexibility but it also admits the greatest number of hazards, in fact just about all those which follow.

Having said this, let me summarise some of the things to watch for, and which will apply in varying degrees to the situations listed above.

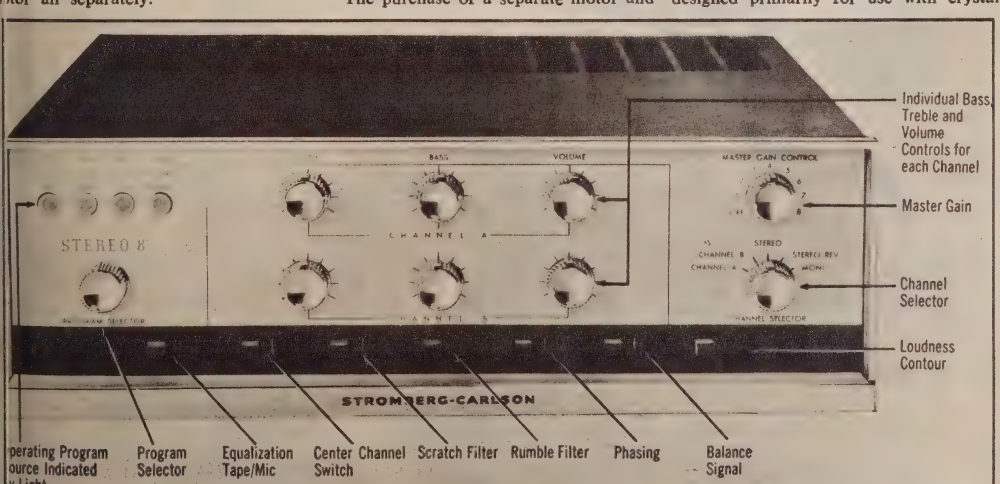
HUM PICKUP: By their very nature, magnetic cartridges are prone to pick up hum from mains transformers, sometimes up to a couple of feet away, and from the turntable drive motor.

Power transformers, or the whole amplifier, can often be orientated for minimum hum pickup but the relationship of motor and pickup is much less flexible.

Be particularly wary of turntables where the motor is directly under the arc of the pickup's travel. It won't matter to a crystal cartridge but it can spell disaster to many magnetics, probably most.

A few magnetics are notably free from hum pickup and will operate directly above the drive motor. They are the exception, however, rather than the rule.

BEARING STIFFNESS: Pickup arms designed primarily for use with crystal



Manufactured by Stromberg Carlson, America, this 64-watt stereo amplifier would keep most audio enthusiasts occupied—for a while! It will accept input from magnetic or ceramic pickups, tapehead or tuner. Outputs are available at 4, 8 or 16 ohms, along with an optional third (A plus B) channel outlet. Preamplifier heater operates on DC, hum and noise is 70db down and distortion less than 0.6 per cent at full output.

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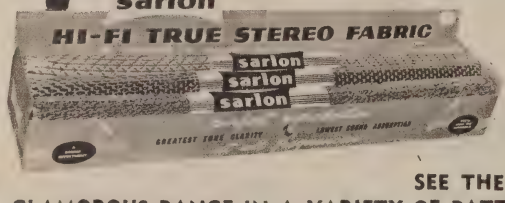

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or old mono magnetic cartridges may have excessive stiffness or side-thrust characteristics by modern standards. Though satisfactory enough with a stylus tracking pressure of 7 or more grams, they may not permit tracking weight to be reduced to the 2 or 3 grams considered appropriate for a modern stereo magnetic cartridge.

The situation has continued to improve since the advent of stereo but any mass-produced arm should be examined carefully before it is assumed capable of operating properly with a high performance magnetic cartridge.

COMPATIBILITY: In the writer's experience, a magnetic cartridge having an 0.7 mil stylus and flow dynamic stylus mass will usually play all mono and stereo grooves cleanly and at a modest stylus pressure (2 to 3 grams).

PERFORMANCE VARIES

This is not true of all magnetic pickups, various design limitations leading to groove "rattling" or "skating" on heavily modulated mono or stereo tracks. The result is an unpleasant "buzz" or "edge" to the reproduction.

This has led some to the assumption that no stereo pickups are really compatible; that a separate mono LP head is necessary. Others simply maintain that separate stereo and mono heads are good practice, anyway.

In short, opinions—and the reasons for them—differ on the subject of compatibility but the enthusiast should consider the facility and availability of interchangeable heads.

INSTALLING CARTRIDGES: Don't be misled by references to "standard mounting centres," etc. The mounting centres may indeed be a certain distance apart but, in almost every type of cartridge, the actual mounting surface differs, as also does the position relative to the stylus tip. In some cases the inclination of the cartridge is of vital importance.

Some "universal" arms are accompanied by a variety of screws, washers and distance pieces, which are most essential in practice.

A wise precaution, before attempting an interchange of heads, is to secure beforehand a few long 8BA countersunk screws, together with nuts and washers. These can usually be pressed into service, if no other "hardware-in-miniature" is provided.

TRACKING: "Universal" pickup arms are usually accompanied by tracking diagrams, vital dimensions being the distance from the turntable spindle to the vertical pivot and the "overhang" of the stylus beyond the spindle. Observe these data and you won't go far wrong.

STYLUS POSITION

It is possible, however, to be very badly caught when installing a new cartridge in an arm which is permanently fitted to a playing deck. Unless care is taken, the new stylus may occupy a position relative to the head shell, quite different from that of the earlier cartridge.

In some cases it may be very difficult to achieve the same effective stylus position as, for example, when the terminal arrangements of the new cartridge foul the internal connections of the shell.

In such a case, it will be necessary to examine the position critically with the stylus located as well as possible, to see whether the resultant tracking error can be tolerated. Possibly the error may be corrected by inclining the cartridge slightly inside the head shell. Moving the whole arm is another possibility but this is seldom feasible in a composite playing deck.

This can turn into a "won't go" proposition, making it necessary to select another and more suitable cartridge.

PLAYING WEIGHT: The playing weight for an individual head can usually be adjusted to optimum by adjustment of the arm itself (where the facility is provided) or by the addition of small permanent weights.

Individual cartridges vary considerably in weight, however, and interchanging heads, etc., may involve problems arising therefrom, if the need for frequent adjustment is to be avoided. It may be necessary, for example, to weight the lighter head assembly and adjust the arm accordingly, so that correct playing weight is obtained when either is attached.

Some cartridges are exceptionally heavy and may require more than the amount of counterweight or counter spring pressure provided in certain arms.

NEGRO SPIRITUALS — "worth every penny of its purchase price."

In exceptional cases, it may be necessary to examine the whole assembly with a view to removing physically any unnecessary mass.

MAGNETIC ATTRACTION: Some magnetic cartridges are attracted to steel turntables to a degree which significantly increases the anticipated tracking weight. The effect is not present with non-ferrous turntables and can be minimised by raising the record off a ferrous turntable with a thick (usually rubber) mat.

STYLUS INCLINATION: The clearance of the stylus tip outside the cartridge housing, the frontal and side inclination of the stylus relative to the record surface are all significant and must be studied, if best results are to be obtained. In most cases, one can sight off the surface from which the stylus tip emerges.

LOAD IMPEDANCE: Most magnetic pickups operate into an output load of from 47,000 to 100,000 ohms and show little reaction to variations within this general range. When using interchangeable "high impedance" heads, even of different brand, it is usually possible to settle for one suitable, compromise value.

Where a cartridge requires to feed into a coupling transformer, the problem has to be approached much more critically.

OUTPUT AND RESPONSE

Last but not least, I should perhaps include reference to something which will be obvious to most but which still catches some out.

The output and the frequency response of a magnetic cartridge are completely different from that of a crystal cartridge and the two are not normally interchangeable. It is therefore quite futile to attempt to interchange one for the other without an appropriate (and usually considerable) modification to the associated amplifier equipment.

A REVIEW OF SACRED RECORDS

GOSPEL SONGS by DOUG and DON and ALL THE KING'S MEN, Directed by Donald G. Newman. Mono, Radiola RL 1502.

Over the past few months, this group of young men has become very well known in Sydney and environs, by reason of their broadcasts and their Gospel meetings in local churches.

The sixteen numbers here are typical of those used in such activities, being partly vocal, partly instrumental. I imagine that the considerable teenage following, which the group has, will give the record plenty of work, as a result.

The older generation of church folk will also enjoy much of the contents but not, I fear, where brass is featured. Trumpet, trombone, etc. may provide good spectacle on the platform but the result isn't always as successful as straight audio. Some "polishing up" would appear to be desirable in this department.

Technically, the disc is recorded well and, for followers of "The King's Men," the jacket carries an excellent group photograph in colour.

* * *

NEGRO SPIRITUALS, produced by Cyril Ornadel. Stereo, World Record Club, MW 2005.

You'll search a long time, I think, before you find a collection of negro spirituals even to approach this one. It contrasts vividly with the many so-called spirituals that are served up, these days, on record and which are neither negro nor spiritual.

The items in this album are boisterous and exuberant where they should be, yet just as reverent and sensitive elsewhere.

George Brown, Martin Lawrence, Isabelle Lucas, Geoffrey Taylor and the Linden Singers combine brilliantly with organ and instrumental backing to provide a true program that comes to an end only too soon.

In a stout folder, well annotated, this excellent stereo disc is worth every penny of its purchase price. I can heartily recommend it.

* * *

CHRISTMAS CAROLS, Temple Church Choir, Organist and Conductor, Dr G. Thalben-Ball. Stereo, HMV OCSD 1281.

This disc was nearly overlooked, mainly because it arrived too late for inclusion in our December issue.

In fact, it is in a very different cat-

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Colours: Beige deck, brown arms.

Idler wheel released from turntable.

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ory from the majority of carol re-cordings, which are plainly designed as background to Christmas festivities, to put away immediately thereafter, til they come around again.

Though the theme in this case is still Christmas, the whole presentation is steeped in the atmosphere and traditions of London's historic Round Church, constructed originally by Crusaders of the 12th century. As such, it could be played with pleasure at any time by those with an ear for organ, cathedral and choir.

The record opens with the ponderous notes of the organ, followed by choir and recitation, both heard remotely and depicting in sound the nature of the office. The point having been made, succeeding choir items are recorded closely) with closer microphone placement.

Musically, the presentation is excellent.

Unfortunately, however, the recording is not as quiet as it could be in terms of background noise, tape hiss and surface "pops" being both somewhat in evidence. The recording quality otherwise is clean.

* * *

MUSIC OF THE FREE METHODIST CHURCH, Light and Life Hour Choir, directed by Dr Lawrence Schoenhals. Mono. GFM (Gospel Film Ministry) 49-W3068-LP.

According to the cover notes, the 40-voice "Light and Life Hour" choir is drawn from the Seattle Pacific College and the Seattle First Free Methodist Church. The items on the disc are from material prepared for broadcast presentation.

The result I can strongly commend to anyone—young or old—who has ever responded to the challenge and passion of great congregational hymns.

This is hymn singing at its best—varied in content from traditional to spiritual, simple, passionate, sensitive and always in perfect harmony.

And technically, it's just as good—presence, diction, quality of the highest order.

This one I will recommend without the slightest reservation. You'll enjoy every minute of it.

IN VARIED MOOD

CONGRESS DANCES. Cyril Stapleton and his orchestra. Stereo, Decca SKL.-4071.

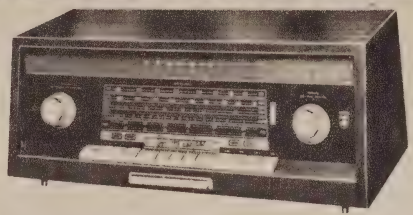
The cover notes are rather vague on the point, but Cyril Stapleton apparently had a notion to recapture the romance and splendour of the celebrations in Vienna, which accompanied the Congress of 1814.

Argue if you will about the validity of his program, but there's certainly no argument about its presentation. This is the sweet, romantic sound that, additionally anyway, recalls Vienna.

Among the dozen or more titles are "Radetsky March," "I Kiss Your Hand, Madame," "When The Lilacs Bloom Again," "Vienna, City Of My Dreams," "You Will Remember Vienna," etc.

The recording itself is excellent, clean, quiet and nicely disposed. If you want a spot of Viennese stereo, done up in lush package, why not this one?

GRUNDIG STEREOMASTER



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LET'S DANCE AGAIN, with David Carroll and his Orchestra. Stereo, Mercury SR60152.

David Carroll, himself a hi fi and amplifier fan, has packed this disc with varied and interesting sound, as well as with equally varied dance tempos. There's plenty of everything.

You can therefore have it either way or both ways, according to your inclinations.

The pressing itself is also right up to standard, with clean sound, good response and negligible noise.

The titles:— "Pretty Baby," "Side Saddle," "Soft Shoe Song," "Adios," "Irene," "Hey Chick," "Cha-Cha Panecas," "Bouncing Ball," "Swamp Fire," "Like To Take A Walk," "Doodlin' Drummer," "Let's Dance Again" and "Play A Simple Melody."

★ ★ ★

INFORMALLY YOURS, Carmen Cavallaro, Stereo, Festival FST 11074 T.

Pianist Carmen Cavallaro has more than the usual ten fingers, if one is to judge by the number of notes and the speed with which he plays them in some of the selections here. Nor is the unnamed guitarist, who makes an occasional appearance, exactly bumble-fingered.

Elsewhere, the mood changes to the dreamy and romantic, often to be interrupted by sudden changes in tempo. Carmen Cavallaro can play the piano and he wants all and sundry to know it. Let there be no dozing while you listen.

An unusual feature of the record is that the melody on each side is unbroken, the individual numbers being linked by melodic interludes bridging the gap in key and tempo.

Technically the recording is clean, apart from some slight blurring in "Sabre Dance." But at this speed one can hardly blame the poor stylus.

★ ★ ★

EXOTICA, The Sounds of Martin Denny. Stereo, London SAHA 6062.

How many different sounds and moods can a man create, given a baton, a band and a menagerie? This record will at least give you some idea.

Denny's formula is to select a basic melody, preferably "atmospheric," then overlay it with all kinds of sound improvisations, ranging from straight percussion to electronic tricks and sound effects appropriate to "The Three Stooges."

But the result is never confused. Denny knows what he wants and gets it. What's more, the record passes it on, without a trace of noise or a whisper of distortion. A good stereo show-disc, if you want some unusual sound-cum-rhythm.

Typical titles are: "Quiet Village," "Hong Kong Blues," "Lotus Land," "China Nights," and "Waipio."

★ ★ ★

TABOO VOL. 2. New Exotic Sounds of Arthur Lyman. Stereo. Hi Fi Record SR822.

Unusual sound effects are also Arthur Lyman's long suit as he conducts the listener on an audio-atmospheric tour from jungle to seashore and points between.

In general Lyman offers more sound and less melody than Martin Denny, reviewed above, though two or three numbers are notably tuneful—"Hi Lili, Hi Lo," "Beautiful Kakana" and "Moon of Manakoora."

Technically there's nothing much to choose between the discs—both are excellent. You'll select one or the other, I imagine, on the basis of "melody-to-noise ratio," a term which for once has nothing to do with the mechanics of recording.

★ ★ ★

MARCHING WITH THE COLDSTREAM GUARDS, Conducted by Major Douglas A. Pope, A.R.C.M. psm. Stereo, RCA SL 10704.

The band of the Coldstream Guards plays here exactly as one would expect of one of England's most famous military bands. In two long sides, there's hardly a note or a beat out of place.

Nor are there any tricks or gimmicks. These are well-known marches—played as marches—lacking only the rhythmic beat of marching feet.

"Sons Of The Brave," "Bond Of Friendship," "Standard Of St. George," "Quarter Deck," "Viscount Nelson" are some of the titles.

The recording itself is first rate, with only two blemishes which I'll forgive without a quibble—a slight groove echo in a couple of spots and what sounds like a tape accident which renders uncertain the pitch in the opening bars of "The Contemptibles."

Still a mighty good "straight" band record.

★ ★ ★

CUBAN MOONLIGHT, Stanley Black and his piano, with Latin-American rhythms. Stereo, Decca. SKLA-4025.

This is Latin-American music. It must be; it says so on the cover and it features the appropriate kind of percussion.

Well perhaps it is, but it's mainly Stanley Black, with his fluent, easy-to-listen-to presentation at the keyboard. It's bright, yet relaxing, but never monotonous. In short, pleasant "background" music.

And the disc itself is above reproach—worthy of any piece of hi-fi gear, if your taste happens to lie in that direction.

A few titles:—"Ay-Ay-Ay," "Stars In Your Eyes," "The Moon Was Yellow," "Nostalgia," "Perfidia" and "Frenesi."

★ ★ ★

COME TO THE CEILI, Favourite Irish Dances, The Gallowglass Ceili Band, directed by Pat McGarr. Stereo, Top Rank. STRL-325T.

Though not Irish by descent, I can imagine that these dance tunes would have the intended effect upon anyone who is.

The small "family" style band, which seems to have had a good deal of success in Irish National Competitions, play two marches, five reels, eight waltzes, two hornpipes, six jigs and five military two-steps—all in impeccable tempo.

But while excellent as a background to Gaelic festivities, the very prominent button accordion gets a bit monotonous, as pure audio fare, after a few tracks. In short—excellent atmosphere to be taken in small doses.

Technically, the recording is clean and noise-free. But don't expect too much of the stereo. With the accordion firmly in centre stage, it isn't too obvious where the rest of the group are.

But does it matter? Stereo or mono, begorrah, the Oirish'll luv it.

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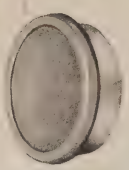

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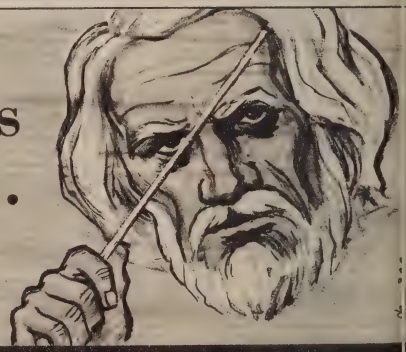

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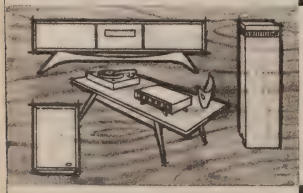

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IN REVIEW—By JULIAN RUSSELL

BEECHAM—"Air of Authenticity"

Handel — The Messiah. Complete Oratorio. Jennifer Vyvian (soprano), Monica Sinclair (contralto), Jon Vickers (tenor), Giorgio Tozzi (bass). The Royal Philharmonic Orchestra and Chorus conducted by Sir Thomas Beecham. RCA Stereo SLD16210/1/2/3/4.

Handel—The Messiah (Abridged). Philadelphia Orchestra and Mormon Tabernacle Choir with Eileen Farrell (soprano), Martha Lipton (contralto), Davis Cunningham (tenor), William Warfield (bass), conducted by Eugene Ormandy, Coronet Stereo KLCS 2707/8.

Here are two very different accounts of the well-loved oratorio, both of which might have surprised its composer. Neither conductor uses an eighteenth-century orchestra. Beecham's version was re-scored by Sir Eugene Goossens who has included such esoterica as trombones, percussion in rich variety, and occasionally even a harp glissando.

Yet despite this extreme dissimilarity from the original instrumentation there is an impressive air of authenticity about the whole performance. And Beecham, in a note that appears in the very beautiful, Swiss-printed booklet which accompanies the set, offers a convincing reason for using an altered score.

"Sixty years' study of (Handel's) life and works," he writes, "have led me to think he would have raised little objection to some modernisation of the instrumental portions of his oratorios."

And he goes on to point out that Handel, like Mozart, enjoyed "great demonstrations of sound" and that only the restricted orchestral resources of the eighteenth century prevented him from deploying very much larger forces than were available at the time.

But though Beecham has "enriched" the original version he has been careful not to indulge himself in the use of the vast vocal and orchestral combinations that were popular from the middle of the last century. He has just made it all sound, in his opinion, more acceptable to an audience with "the opulent sound of a latter-day orchestra well in its ears."

The result, to this listener's ears, is superb. The choral singing is peerless in its accuracy and sensitivity, and the soloists, if one sometimes has to overlook a rather pallid soprano, are all supremely good. Beecham directs the whole with unrivalled authority and a freshness of approach that brings renewed pleasure to those satiated with stodgily pious Christmas routine performances.

If you want to sample just two of the many felicities that make the performance so memorable, listen to the startling entry of the brass at the climax of the overture and the tenor's crescendo at the beginning of "Comfort ye."

The entire singing force seems to share one vibrant intelligence.

And to all these merits can be added sound that has so far been unsurpassed on two-channel reproduction.

The Ormandy version, also a "modernisation" but more in the Victorian manner, has great tonal richness and has been abridged to fit on to two 12in discs. Ormandy has a truly great soprano in Eileen Farrell who uses her fine dramatic voice with magnificent effect.

And in this version, too, splendid discipline is always maintained among singers and orchestral musicians. But Ormandy has been content to accept many of the conventions that have grown up around an "orthodox" presentation of the Messiah during its long, popular history, and if you are prepared to accept this treatment as valid, the Coronet set can be recommended to those who wish to own a performance in a more compendious presentation.

The stereo in this, too, is wonderfully spacious and faithful.

★ ★ ★

Bizet—Carmen. Complete Opera. Victoria de los Angeles (Carmen), Nicolai Gedda (Don Jose), Janine Micheau (Micaela), Ernest Blanc (Escamillo), Denise Monteil (Frasquita), Marcelle Croisier, Monique Linval, (Mercedes). French National Radio Orchestra and Chorus conducted by Sir Thomas Beecham. H.M.V. Stereo OASD331/2/3.

The imperishable distinctions and awe-inspiring authority that gave the previously-issued mono version such tremendous direction are even enhanced in this superb stereo set. It is extremely doubtful that a better Carmen will be produced for very many years to come.

In such a long work it would be miraculous to find a performance without a trifling blemish here and there, and after all, this version was produced by human, and not superhuman, beings. But generally speaking, this is as near perfection as any reasonable critic could desire, and once again Beecham's eternally youthful approach to a hackneyed score should provide enjoyment for even the most jaded palates.

In my opinion, no library of recorded operas would be complete without this Carmen.

★ ★ ★

Stravinsky — The Rite of Spring. Philharmonia Orchestra conducted by Igor Markevitch. H.M.V. Stereo ASD313.

I can recommend this disc with considerable enthusiasm though I must confess to a personal preference for the Monteux performance for R.C.A. Monteux, by the way, conducted the Paris premiere of the ballet to its now-famous accompaniment of whistles and fist-fights.

Markevitch concentrates on the more brutal aspects of the work and brings off some quite startling effects. But his reading still remains unquestionably musical despite the urgency of its dramatic progress. He lets the climaxes blaze without ever overpowering him, and makes them sound even more than usually overwhelming by reaching them from a low-lying, pianissimo point of departure.

Admittedly these forceful statements can be reproduced at their best only by resolutely disregarding your neighbour's tolerance of levels. But once your better instincts have been brought under callous control you will find the result very heady indeed.

In the matter of reproduction of the enormous amount of detail in the complex score, I find little to choose between the Markevitch and Monteux versions. In both, the inner voices emerge with delicious transparency of texture and accuracy of execution. And both, too, were directed by enormously sophisticated intelligences. As hinted earlier, your preference will be purely personal.

★ ★ ★

Beethoven—Symphony No. 7 in A Major, Op. 92. The Cleveland Orchestra conducted by George Szell. Philips Gold Label Stereo GLS24.

Berlioz—Symphonie Fantastique, Op. 14. The Hague Philharmonic Orchestra conducted by Willem Van Otterloo. Philips Gold Label Stereo GLS22.

Schubert—Symphonie No. 7 in C Major (The Great), The Cleveland Orchestra conducted by George Szell. Philips Gold Label Stereo GLS32.

Haydn—Symphony No. 103 in E Flat Major (Drum Roll), Symphony No. 104 in D Major (London). The Lamoureux Concert Orchestra conducted by Igor Markevitch. Philips Gold Label Stereo GLS27.

Brahms—Symphony No. 2 in D Major, Op. 73. Variations on a Theme of Haydn, Op. 56a. The Vienna Symphony Orchestra conducted by Wolfgang Sawallisch. Philips Gold Label Stereo GLS16.

Album of Classical Favorites. "Unfinished" Symphony (Schubert) and "Italian" Symphony (Mendelssohn). Vienna Symphony Orchestra conducted by Wolfgang Sawallisch; "New World" Symphony (Dvorak). Concertgebouw Orchestra of Amsterdam conducted by Antal Dorati; "Italian" Symphony (Mendelssohn); Symphony No. 5 in C Minor and Symphony No. 8 in F Major (Beethoven). Lamoureux Concert Orchestra conducted by Igor Markevitch; Polonaises (Chopin). Alexander Uninsky, pianist. Philips Gold Label Stereo. GLS17/20/23/26.

Handel — Concerto Grossi in G Major, Op. 6, No. 1; F Major Op. 6, No. 2; E Minor, Op. 6, No. 3, Handel Festival Orchestra (Halle) conducted by Horst-Tanu Margraf. Philips Gold Label Stereo GLS33.

Handel—Concerto Grossi in A Minor, Op. 6 No. 4; D. Major, Op. 6, No. 5; G Minor, Op. 6, No. 6. Handel Festival Orchestra (Halle) conducted by Horst-Tanu Margraf.

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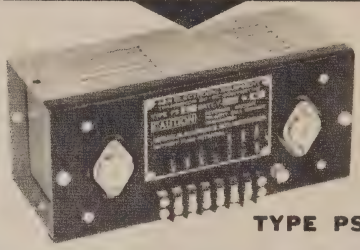

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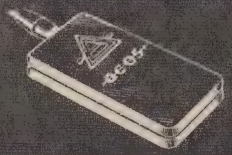

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Philips Gold Label Stereo GLS34.

Strauss (Johann, Jnr.) Waltzes. Vienna Symphony Orchestra conducted by Paul Walter. Philips Gold Label Stereo GLS29.

To economise on space I have bracketed together the whole massive first issue of this new label that offers very good stereo performances of "popular" classics at the low price of 39/6 a disc. A factor that makes them an even better bargain on examination is the fact that they are not re-issues deleted from Philips' regular catalogue, but quite new performances on the local market.

The best is, I think, the Berlioz Symphonie Fantastique, which while perhaps never quite achieving all the qualities of Beecham's memorable disc, nevertheless has much to recommend it. It is splendidly nervous throughout, with good sound, a clean surface, and an effective, though not unwieldy, dynamic range.

Another admirable buy features Szell and the Cleveland in Schubert's "Great" C Major Symphony, a performance characterised by all the conductor's customary immaculacy of phrasing and inflection. The stereo separation is modest yet effective and the orchestra tone a trifle on the light side. But it represents outstanding value at the price.

There is more marked stereophonic treatment in the same combination's performance of Beethoven's Seventh Symphony, another first-rate buy though this faces formidable competition — in a higher price range — from recently issued discs by Walter and Klemperer.

I can also enthusiastically recommend the two Haydn Symphonies played with firm sensitivity by Markevitch and the Lamoureux. Purists may find some of Markevitch's tempos unusual, but they are all undeniably valid, and the string tone is strikingly expressive throughout.

The disc that appealed to me least was the Brahms Second Symphony of Sawallisch and the Vienna Symphony. The playing here is sometimes ragged and the sound is occasionally thoroughly unpleasant. Moreover the conductor's interpretation never rises above the pedestrian. The St. Anthony Variations are in much the same class.

The Album of Classical Favourites, the items in which are set out in detail above, would make a very good foundation for a modest library of discs of that type.

★ ★ ★

The Reiner Sound — Rapsodie Espagnole; Pavane for a Dead Princess (Ravel). Isle of the Dead (Rachmaninoff). Chicago Symphony Orchestra conducted by Fritz Reiner. R.C.A. Mono L16268.

I found this ever so slightly disappointing, perhaps because I have lately come to expect such an exceptionally high standard of performance from Reiner and his orchestra. The playing here is as accomplished as ever, if tiny untidinesses of attack in the first movement of the Rapsodie are excepted.

My main disappointment was in the extremely slow tempos used here and there. Prelude a la Nuit, from the Rapsodie is a case in point. Reiner's ultra-slow tempo establishes the atmosphere of a hot, tropical night but misses expressing much of its perfumed mystery. And in the final movement Reiner barely keeps the musical thought moving.

Balancing these shortcomings you will find true Iberian voluptuousness in the Malaguena and Habanera, and a Pavane that reminds one that the Princess, and not the music, is dead. The Feria, in the Rapsodie, presents a brilliant bit of pointillist sound.

But, however good these items may be, I felt it was the Rachmaninoff that displayed Reiner at his best. Here the music presents a smooth face of great weight and authority, and the menacing atmosphere of the giant, brooding rock of Bocklin's picture, which it illustrates, is most poetically evoked.

★ ★ ★

Stravinsky — Firebird; Suite from the Ballet. Ravel — Mother Goose Suite.

Bizet — Jeux d'Enfants. Suite from the ballet. Philharmonia Orchestra conducted by Carlo Maria Giulini. World Record Club. Stereo TE2 30.

This disc offers splendid stereo sound at the inexpensive price of 39/6, despite slight evidence of the prevailing tendency, on all labels, to over-resonance. But much of the music is shaped rather too carefuly for my taste.

In the Stravinsky the beat is severely regular in the Firebird's Dance, and the Ronde des Princesses trails along slowly and listlessly with the addition of quite alien extravagances of inflection. This over-inflection is again evident in the Berceuse, with the result that it sounds as if it is being played slower than is actually the case.

Some of the items come off very well indeed — Kaschei's Dance is one. And the final Chorale has truly tall dignity.

The Bizet suite also sheds a little of its characteristic liveliness as a result of over-affectionate treatment, though there is no lack of sparkle in the brilliantly executed finale. Some of the Mother Goose Suite goes at a pace that is truly soporific.

★ ★ ★

Music of the Medieval Court and Countryside for the Christmas Season, New York Pro Musica conducted by Noah Greenberg. Festival Mono FL7185.

Music of the Renaissance. New York Pro Musica conducted by Noah Greenberg. Festival Mono FL7228.

This combination has, in a very short time, acquired an enviable reputation in America and Europe for authentic recreations of ancient music achieved by the diligent scholarship of its founder and director, Noah Greenberg. Those who enjoyed their quite wonderful Play of Daniel for Festival will not be disappointed in these new issues.

Greenberg again uses archaic instruments, whenever possible, or if unobtainable, expertly built modern models of the originals, all of which impart to the sound a novel timbre for twentieth century ears. Every note has been recorded with such clarity and transparency of texture that it is difficult to imagine the mono sound being improved by transfer to stereo.

On the first disc you will find dances for various combinations of instruments, and songs, both religious and secular. The last are for the most part expres-

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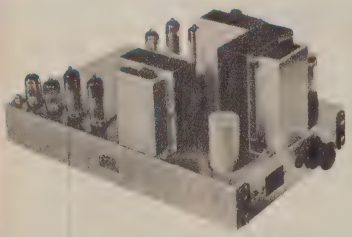

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sively delivered by accomplished singers, including that distinguished counter-tenor, Russell Oberlin. Betty Wilson (soprano), Jean Hakes (soprano), Charles Bressler (tenor), and Brayton Lewis (bass) are the others.

A small but superbly disciplined choir features in some of the items.

On the disc of Spanish Music some of the composers are anonymous, though those who are named will be known only to the most erudite authorities on the period. All the numbers are entirely delightful and should provide delicious entertainment for both scholars and tyros alike.

★ ★ ★

A Recital of Lute Songs. Peter Pears (tenor) and Julian Bream (lutenist). Songs by Dowland, Rosseter, Morley, Ford, Pilkington and Campian. Decca stereo SXLA2191.

This disc, too, offers a delicious recital of ancient music, but here it is early seventeenth century English. Again much of the contents will be new to almost every listener. The program includes love songs, religious songs, and humorous little trifles of ravishing design.

Peter Pears sings them all with dedicated good taste, though there are occasional bars in which he seems to be a little too precise for comfort, so that some spontaneity is lost in his effort to achieve perfection. But generally speaking they are all eminently enjoyable, and Julian Bream's accompaniments are perfect enough to tempt one to describe him as the Gerald Moore of the lute.

★ ★ ★

Tippett — A Child of Our Time. Oratorio. Elsie Morison (soprano), Pamela Bowden (contralto), Richard Lewis (tenor), and Richard Standen (bass). The Royal Liverpool Philharmonic Orchestra and Choir conducted by John Pritchard.

Ritual Dances from The Midsummer Marriage. Orchestra of the Royal Opera House, Covent Garden, conducted by John Pritchard. Pye Acclaimed Series PLC 5015/6.

This example of what might be called twentieth century Passion Music has its impressive moments. It was first performed in 1941 and is perhaps best described by Scott Goddard's article on the composer in Grove's Dictionary of Music. He writes:

"In an age of peculiarly embittered ideologies, Tippett's attitude is not political but religious. The child killed in our time by one totalitarian group stands for millions who in former ages have suffered a like fate and for all those of tomorrow; he is a symbol for all bewildered and trapped humanity."

Tippett's composition conforms to the traditional lines of a Passion, with a narrator, choruses and arias. But it differs in one important, and controversial, aspect—the usual chorales are replaced by Negro spirituals. This has the effect of offering unfamiliar music in the main body of the work interrupted by immediately recognisable melodies from another context.

As long as the new sound is unfamiliar to the listener's ears, the spirituals sound a little incongruous. But they settle effectively, and sometimes movingly, into their surroundings on closer relationships with their company. The composition is uneven in quality, but there is no gainsaying its deep sincerity. It is, at its best, agonisingly compassionate; its shortcomings lie in a lack of dramatic stress during climactic situations.

FREELY POLYTONAL

In style it is freely polytonal but avoids serialism. Indeed the composer shows a very strong sense of key anchorage throughout. The performance is altogether admirable except for some difficulty in catching the words sung by the choir—a fault that is, unfortunately, not remedied by an accompanying text, though the sleeve notes inform the stranger of what is going on.

Richard Lewis and Richard Standen are outstanding, and Elsie Morison, though her voice is a little bright for her role, shows complete understanding of her difficult part. Pamela Bowden's notes acquire an odd quality in the upper register, but she, too, sings sympathetically and intelligently.

The Ritual Dances, which occupy the fourth side, are consistently interesting. The orchestration is strikingly original without freakishness and they can be enjoyed for their successful pictorial evocations without knowledge of the rest of the opera. The mono sound is very good in both the Child and the Dances.

★ ★ ★

Bartok—Concerto for Orchestra. Two Portraits. The Royal Philharmonic Orchestra conducted by Rafael Kubelik. HMV Stereo ASD312.

This is a stirring example of modern stereo engineering, marred only by a very slight surface prickle on my pressing. The tonal quality and its distribution are impeccable, and the dynamic range is as wide as anyone needs for playing anywhere outside a large hall—and even there it would be effective if played on proper equipment.

Kubelik and his orchestra offer a virtuoso performance of both works, except for some momentary smudging of an occasional phrase in the brass, too insignificant to cause the most critical listener anything but fleeting discomfort.

★ ★ ★

RECOMMENDED:

VIVALDI — Le Quattro Stagioni (The Seasons). I Musici. Philips Stereo 835030AY.

STRAUSS (JOHANN JNR.). The Vienna of Johann Strauss. Waltzes, Polkas and Overtures. Vienna Philharmonic conducted by Herbert von Karajan.

TCHAIKOWSKY — Selections from Swan Lake Ballet. Orchestre de la Suisse Romande conducted by Ernest Ansermet. Decca Mono LXTA5581.

HANDEL Organ Concertos Vol. 3. Nos. 9/10/11/12/ Karl Richter (organ) and the Karl Richter Chamber Orchestra conducted by Richter. Decca Stereo SXLA2201. Mono LXTA5580.

HANDEL — Organ Concertos Vol. 2. No. 5, 6, 7, 8. Karl Richter (organ) and the Carl Richter Chamber Orchestra conducted by Richter. Decca Stereo SXLA2187. Mone LXTA5579.

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MUCH thought and work is being applied to the problem of intruder operation in the amateur bands by the R.S.G.B. "Intruder Watch." Under the leadship of Major D. W. J. Haylock (G3ADZ), many reports have been provided and furnished to the IARU Member Societies and to the British Post Office via the R.S.G.B.

At the Geneva Radio Conference in 1959 amateur representatives took every opportunity of reporting to Government delegates the seriousness of the mass invasion of exclusive amateur bands by commercial and service stations of many nations.

COMPLEX PROBLEM

The position is very complex, and, while respective Governments can request other nations to take action on offending stations, when that nation was not represented at the Atlantic City Radio Conference of 1947, it seems unreasonable to expect this administration to act.

Actually the Frequency Allocation Table covering the bands below 27,500 kc/s, drawn up at Atlantic City, has never formally been brought into force.

The countries concerned who signed the agreement in Geneva in 1951 did in fact agree to implement the table. This vague position should be cleared up according to an RSGB Bulletin editorial for December, 1960, after May 1, 1961, when the Geneva Frequency Allocation Table comes into force.

It is a well-known fact that other services besides the amateur service suffer from out-of-band working, and is a symptom of the congestion in this portion of the radio spectrum.

PANEL OF EXPERTS

The Geneva Conference appreciated the problem by setting up the "Panel of Experts" (mentioned elsewhere). Substantial progress toward clearing intruders from the bands, it is felt, will only come about as a consequence of the measures that are proposed by that panel and subsequently adopted by the next radio conference.

The work done by amateurs in many countries in recording the intruders operating ensures that administrations are aware of the number of such stations operating and so appreciate the concern with which amateur societies view the intrusion into exclusive amateur allocations.

An investigation is to be carried on the major problems of frequency allocations in the range 4 to 27.5 mc/s. The setting up of a "panel of experts" was listed for action at the 1959 Geneva Radio Conference.

It will consist of the heads of the four permanent organisations of the International Telecommunications Union (Secretariat, International Frequency Registration Board, CCIR, CCITT), plus up to seven additional highly qualified technical experts from various parts of the world.

The panel is assigned the task of studying the congestion at these frequencies and coming up with proposals for a solution. It is anticipated that the personnel will be chosen early this year. They will meet with the permanent officers in Geneva in September and again in 1962.

The "panel of experts" report will then be laid before the ITU administrative council for approval and the possible calling of another radio conference should that be necessary to accomplish the proposed solution.

WIA ADDRESSES

THE following are the addresses of the various divisions of the Wireless Institute of Australia in each State. Intending members or enthusiasts requiring information on AOCP classes and the like should address their inquiries to the locations shown.

New South Wales: 14 Atcheson Street, Crows Nest.

Victoria: 478 Victoria Parade, East Melbourne, C2.

Queensland: Box 638J., G.P.O., Brisbane.

South Australia: Box 1234K., G.P.O., Adelaide.

Western Australia: Box N 1002, G.P.O., Perth.

Tasmania: Box 371B, G.P.O., Hobart.

Papua-New Guinea: P.O., Box 204, Port Moresby.

Beru Contest

THE R.S.G.B.'s Twenty-fourth Beru Contest will be conducted later in the year than usual, on March 11 and 12. The change should provide better conditions and avoid clashes with some VK events.

The contest, as usual, is divided into two sections, High Power (maximum licensed power) and Low Power (maximum input 25 watts). The following is a summary of the rules for the contest, which often provides contacts with some of the more unusual prefixes among British Commonwealth nations.

Duration—the contest (both sections) will start at 0001 GMT on Saturday, March 11 and end at 2359 GMT on Sunday, March 12.

The contest is open to all fully paid up members of the R.S.G.B. resident within the U.K., and to all British subjects outside the U.K., but within the British Commonwealth and British Mandated Territories.

Only the entrant can operate his station for the duration of the contest.

Entries should be set out on one side only of foolscap paper.

They must be postmarked not later than April 1, 1961, and addressed to the Contest Committee, R.S.G.B., 28/30 Little Russell Street, London WC1, England.

DETAILS REQUIRED

The cover sheet must show claimed score, section entered, name, callsign address, transmitter description, power input, receiver description, and antennas used, together with a declaration that the station has been operated in accordance with the rules of the contest; also an agreement that the council of the R.S.G.B. decision shall be final and as to the maximum input to the final stage.

Log sheets should be set out in the following order:—Date, Band, Time GMT, Serial number out, serial number in, Blank space, Bonus points claimed, Points claimed.

Operation is restricted to the following bands, 3.5, 7, 14, 21 and 28 Mc/s. C.W. only to be used and reports of T8 or less may lead to disqualification.

Contacts may be made with any station using a British Commonwealth callsign except within the entrant's own call area. Only one contact on each band with a specific station will count for points.

Scoring: Each complete contact will score 5 points. In addition a bonus of 20 may be claimed for the first contact with each new Commonwealth call area on each band.

Serial numbers must be exchanged in accordance with the usual practice. Six figures RST plus 001 for the first contact, plus 002 for the second and so on.

Awards:—A trophy will be awarded to the winner in each section and certificates to the first three entrants in each section.

A certificate will also be awarded to the leading station in each call area under certain entry and scoring arrangements.

WIA Convention

THE 11th Annual Postwar convention of the N.S.W. Division of the WIA was held over the Australia Day weekend in January. The first session of the convention was the general meeting held at Science House, Sydney. On the following day, Saturday, there was a gathering at the VK2W1 grounds, Dural and on Sunday a mobile rally was conducted with the assembly after the operating period again at Dural.

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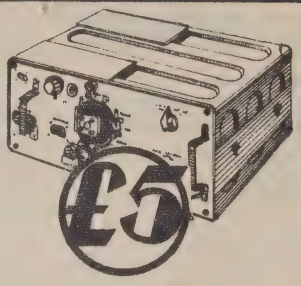

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6A6	10/6	6SR7	12/6	85	10/6
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CATHODE RAY TUBES

3AP1	3in	37/6	VCR97	6in	29/6
3BP1	3in	37/6	VCR131	12in	75/-
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300 type. Wide range of coil resistances from 15 to 50,000 ohms. Prices from 10/6 to 15/-.

600 Type. 200 ohm, 250 ohm, 600 ohm. All 10/6 each. Large range of other types from 6 to 250 volt and wide ohm selections and contact combinations. 10/6 to 70/-. Please call and select.

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3 Position spring loaded centre off Toggle Switch . . . . . 5/-.
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4 Terminals, change over Micro switches 6/6
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Heavy duty, on and off switch 2/-
(Post 1/6.)

Dozens of other types, too numerous to mention are available for personal shoppers.

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Irish recording tape, 1,200ft wound on to standard 7-inch plastic spools.

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3/16 Co-ax Cable

1/6 per yard

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DO YOUR OWN TRANSMITTING WITH THIS

No. 38 SET

Complete with spare set of valves control box, aerial, headphones and microphones. Approx. range —2 miles.

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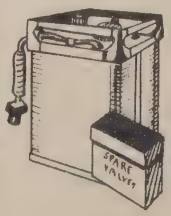

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With standard turnover cartridge for 78 and L.P. records.

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No. 78	Radio and T.V. laboratory manual	3/9
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Lecturer at the initial session at Science House was John Crocker of the Department of Civil Aviation who explained the intricacies of F.S.K. It was an interesting discourse and must have been well received as later in the evening a Notice of Motion of F.S.K. was recorded. It was to the effect that the Division should request that facilities for F.S.K. working on all amateur bands be granted.

It was also decided at the meeting that Box 1734, G.P.O., Sydney, should remain the address for the QSL Bureau not the Administrative Headquarters at Crow's Nest.

The meeting also elected the N.S.W. Divisions' Federal Councillor for 1961.

Past State president, Perc Healey, VK2APQ, was elected to the post. Perc needs no introduction to Australian amateurs. He had already served in the position and has held many executive offices in the WIA. The retiring councillor was Dave Duff, VK2EO, a well known personality in WIA affairs.

GOOD ROLL UP

217 persons registered for the Dural Session on the following day's event with the total attendance well over the 300 mark. With the temperature around the century mark most amateurs were content to yarn under the available shade.

It was only the announcement of disposals sales that broke the lethargic spell and sent persons scurrying towards the dispersing centre.

The only other sign of real activity was in the final of the men's blindfold hunt, when Phil Irvine, VK2ZPI, and Graeme Jessop wandered off into the scrub and, realising their error, beat a hasty retreat toward the halo antenna. All attending appreciated the opportunity to have a quiet talk and view at their leisure the exhibits provided.

State president Bill Lewis, VK2YB, officially declared the day open at 2 p.m.

Displays were provided by the VHF and TV group, the SSB gang, a transistor and transistorised equipment show by Harold, VK2AAH, and old-time equipment by Joe Reed, VK2JR.

There were also a number of quizzes and other competitions to hold the interest of those attending and the day was ended with a film display, which concluded at 10.15 p.m.

During the evening session there was a Dutch auction for a B/C receiver, two quizzes, one technical, one non-technical.

OLD TIMERS

It is pleasing to see so many old-timers assemble at these events and among those noticed was Ray Alsop, VK2NA, Wal Hannam, VK2AXH, Joe Reed, VK2JR, Ray Carter, VK2HC, Lionel Todd, VK2LS.

Gerry Sabin, VK2AGS, and Ken Scott, VK2XS, did their best to alleviate the heat problem by successful operation of the 809's. Ken's jnr. operator showed the most initiative on the day. He was active around the disposals shed during the free hand-outs, collecting pieces that he finally sold for 5/ to buy the O.M. a tuning unit.

Most activity was around this disposals sale, where Barney Smythe, Keith King, VK2ABK, Dave Melbourne, VK2NK, Vol Molesworth, VK2VO, Norm Beard, VK2ALJ, and other helpers cleared a five-ton truck load of much useful equipment.

Winners of some of the events were as follows: Morse code test: 1st, Bill Storer, VK2EG; 2nd, Bob Winch, VK2OA; 3rd, Roy Rayner, VK2DO. The written quiz covering amateur technical, DX, etc., subjects was won by Sandy, VK2ZEX, with Bob, VK2OA, again in second place.

Muriel, VK2AIA, proved far too good for the O.M.'s in the judging of the frequency of tuned circuits. She won the prize for both the HF and VHF sections.

In the blindfold hunt Susan Adams, VK2JX, junior outran the girls, while VK2JX's protege, Greg Mackay, was too good for the boys.

Mrs Wheaton, XYL of VK2AWW, won the ladies' section, and Graeme Jessop, the O.M.'s.

The ladies' auxiliary did a grand job on the day with their tea and scones department; gallons of brew was dispersed. The many workers from the division must be congratulated on providing a day of such interest.

A mobile rally, the final event for the convention, was held on the Sunday. It was arranged so that competitors could choose their own starting point, which had to be at least 20 miles air-line from VK2WI, Dural.

The object was then to travel to VK2WI, Dural, and work as many stations as possible en route. The operating period was 2½ hours, three points scored for contact with other mobile stations and one point for contacts with fixed stations. There was a penalty of one point for each minute late at the assembly point, VK2WI, Dural. This was deducted from the score.

Lunch was served at VK2WI and an inspection of the mobile equipment followed.

The winners of the three sections in the mobile rally were as follows: Outright score (combined) HF and VHF contacts), Jim Cuming, VK2PM; H.F. section, Harold Burtoft, VK2AAH; VHF section, Dick Norman, VK2ZCF.

AOCP Class

THE N.S.W. Division's new AOCP class commenced on March 1 and it is not too late to join. Any inquiries should be addressed to the secretary, WIA, N.S.W. Division, 14 Atcheson Street, Crow's Nest. Classes are held twice weekly at that address, Monday and Wednesday evenings, 7 to 9 p.m. The classes cover the electrical, radio theory and regulation papers for the examination for amateur operators.

Facilities will also be available for morse practice on suitable evenings.

VHF and TV Section

LECTURERS at the February meeting of N.S.W. VHF and TV section were John Lark, VK2ZAV, and Barry Goodman, VK2ZAG. They discussed typical VHF layouts, John covering the receiving side and Barry transmitters.

The section discussed the request for 144 mc/s. mobile units by the Blue Mountain section for use on Saturday, February, 18. WICEN had been requested to provide communication in the B.M. area during a civil defence organisation exercise.

WICEN will have a number of stations located on the route from Sydney to Katoomba when "Operation Picnic"

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Recording Tape, U.S.A., Irish brand 1,200ft	30/-
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Spaghetti sleeving, all sizes, 3d per yard.	
1,000 yds. p.v.c. Telephone Wire	7/6
807 valves	12/6
V.R. 101 (6B 6 G) valves	5/-
6 T 7 Valves	5/-
4-Core Cable, 220 yds.	£7/10/-

We will send sample of this cable anywhere. 1/- per yd. in small quantities.

Tropical developer, M.Q. 1½ gall. tin	2/6
Sodium Sulphite 14lb tin	10/-
35 mm fine grain pan film, 50ft	10/-
35mm Positive film, 50ft	19/6
16mm movie camera g45 with mag.	£5/10/-

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GET YOUR AMATEUR LICENCE

The N.S.W. Division of the Wireless Institute of Australia will provide a course of 56 lectures, for beginners, to prepare students for the Amateur Certificate of Proficiency examinations to be conducted by the P.M.G. Radio Branch in October, 1961.

This course which covers both theory and regulations, will begin on Monday, March 6th, and continue on Monday and Wednesday nights from 7 p.m. to 9 p.m. Excellent roneo notes are available.

Lectures will be held at the W.I.A. Clubrooms at 14 Atchison Street, Crow's Nest. Course fee 10 G.

Intending students should contact the Secretary (Mr Beard) at the Clubroom or phone XW0459 after hours.

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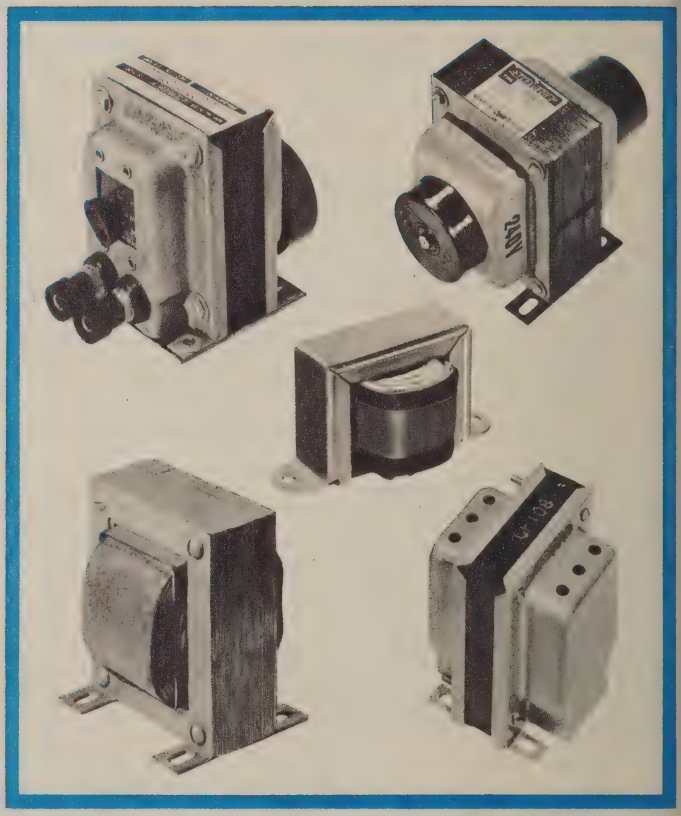

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will be conducted by C.D.O. The VHF and TV section members will supply the additional mobile units requested.

3.5 Mc Band

THE 3.5 mc/s band showed definite signs of the changing sun spot cycle during January. American stations on CW were plentiful during the early evening and the static level was surprisingly low. All W call areas appeared at times, and JA's were also audible during these periods, signals often peaking at S7.

Outstanding signal from the U.S. was W6BYB, who runs 800 watts to a ground plane—quite an antenna arrangement at these frequencies. Another excellent signal came from JAICRT/MM, operating from the mid-Atlantic.

Around Sydney the best time for contacts was around 1000Z. The JA Mobile Marine was surprised to work with ZL and VK stations.

Gosford Club

THE January lecture of the Gosford Radio Club, Central Coast section of the W.I.A., was presented on antennas by Harold Burtoft, VK2AAH. There was an attendance of over 30 members who appreciated Harold's discourse and answers to questions. It is one subject that interests amateurs who operate on any frequency. They all have to radiate a signal.

144 Mc.

EDDIE PENIKIS, VK1VP in Canberra, is on the lookout for signals from the Sydney area on 144 mc/s. He calls with his beam pointed toward the area on Sunday, Monday and Wednesday evenings at 2030, 2045, and 2100 hrs. east. He listens, after each call, and at this stage has already heard Perc Healy, VK2APQ, at S7.

A newcomer to 144 mc/s in Sydney is ex VK9AN; Alan now signs VK2DN.

Tunnel Diode

LES EARNSHAW, ZLIAAX QRP exponent, and remembered for his SSB contact with Kentucky, using transistorised equipment (a 2N247 and 20MW final) is again in the news for low power working. Les is now operating a Xtal controlled tunnel diode oscillator on CW, and has recorded a contact with Jack King, XL1AOF, 160 miles away. The power input to the diode was IMW output somewhere in the micro watt region—QRP at its lowest.

WAZ Award

ASPIRANTS for a WAZ award will be interested in the following list which clarifies the stations operating in zone 18, 19, and 23. UA0A— O—, P—, S—, T— and W— are in zone 18, while UA0R—and Q lie partly in zone 19. UA0C—, D—, G—, F—, J—, L— and K—are on zone 19. UA0Y is in zone 23. Any of the above suffixes may be preceded by the letter K, which indicates a club station, i.e., UA0KYA would be on zone 25, UA0KJX in zone 19.

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Self-contained Portable 4-Valve 5-Watt Amplifiers, 240 A.C. supply. Separate input for crystal mike and pick-up supplied. Complete wired and tested in attractive metal cabinet. Size 8in x 6in x 4½in. Weight only 12lb, complete with 6in x 9in Rola speaker. **£9/17/6**

INDICATOR UNITS

Brand new and complete with (1) VCR97 C.R.O. Tube. Mu metal shield and sockets. 13 Pots, 8 valves, resistors, switches etc. Ideal for conversion to oscillograph. **£7/15/- ea.**

EXIDE BATTERIES

Brand New in Glass Case. Dry charged.

10 volt 5 amp.

Ideal bench or lab, transistor checking, photo flash etc.

37/6 ea.

"S" METERS

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50 Watts RF 2-20 Mcs. Calibrated. Housed in Grey Crackle Metal Instrument Cabinet. Size 10in x 7½in x 9 1/4in.

With 190 uuf double spaced Variable Ceramic Condenser, Switches, Coil, etc. Weight with front cover, 14lb. Instruction book. Suit ATS xmitter.

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NEW OXYGEN BOTTLE

Complete with Demand Valve AND 0-500 lb. Per Sq. Inch Pressure Gauge.

Ideal Booster Tank for Vacuum Windscreen Wipers, Etc.

30/- ea.

CONTROL BOXES

For BC 433 Receivers. Containing S Meter, Switches, Phone Jack, Pots. Dial. Instrument Globes, Knobs, etc. **57/6 ea.**

TOGGLE SWITCHES

(ALPHA) 2 Way

2 amp. 240 volts. **3/- ea.**

VALVES

6V6	12/6 ea.
6C4 6AG5	2/6 "
2051 Thyratron	9/6 "
VR105/30	10/- "
6SN7 6SL7	10/- "
6J5	10/- "
VR55-6B6G	5/- "
VR150/30	10/- "

Phone Plugs 2/6 ea.
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100mA Chokes. H. duty 15/-
Meter Rectifiers (Mini.) 15/- ea.
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1% Wire Wound Resistors, Assorted Sizes 3/6 ea.
1mfd 600V Block Condensers 2/6 ea.

Key Switches, Assld. Types 2/6 ea.
B/Cast Coils Aer Osc. RF. Known make 5/- ea.
7-Pin Miniature Valve Straighteners 9/6 ea.
Relay Counters. 0-9999 £1 ea.
Head Phones, Low Imp. 13/6 Pair
Rectifiers, 6 or 12 Volts, 4 Amps 37/6ea.
Blower Motor, 24 volts 373/6 ea.
SCR 522 Control Boxes with 5 Position Push Button Switches 15/6 ea.
Regulated Power Supplies, 240 Volts AC, 120 Volts-75 M.A. DC Output £3/10/-
Wave Meters, 160-220 Mcs, with 240 Volt Supply £7/10/- ea.
Instrument Cases, grey, crackle finish 16½in x 12in x 10in 22/6 ea.
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The amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with dress plate to match deck. Output: 4 watts can be used as straight amplifier if required.

Model TR2 incorporates the new Collaro "Studio" Deck which features:—

- **High Fidelity. Frequency response 40 to 12,000 cycles at 7½in per second.**
- **Three 4-pole shielded motors.**
- **Three speeds, 1-7/8, 3¾ and 7½.**
- **Fast forward and rewind, 1200ft in 65 seconds.**
- **Two track.**
- **Light piano key controls.**
- **PAUSE CONTROL**

This has the effect of stopping the transit of the tape past the "Record/Playback" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.

- **TAPE MEASURE AND CALIBRATING DEVICE**

The three digit counter makes the location of any recorded passage the simplest of operations.

- **TRANSCRIPTION TECHNIQUE**

A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 per cent at 7½in per second.

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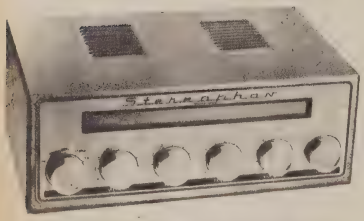

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Complete tuner and amplifier for stereo, comprising a compact Hi-Fi Stereogram in two units featuring a high gain dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls in one unit and two Mullard 5-10 amplifiers with push-pull outputs and power supply on second chassis. **£69/15/-** F.O.R.

Two pair of M.S.P. Jensen speakers or two Rola 12in dual coned speakers supplied. Power output 10 watts per channel (20 watts). Frequency response of amplifier 40 to 15,000 cycles.

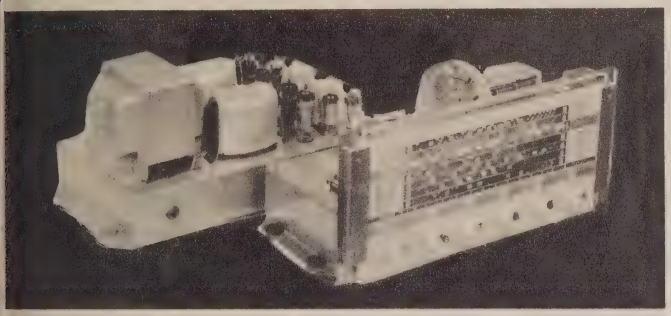
THIS UNIT CAN NOW BE SUPPLIED WITH THE NEW ROLA 12 PX SPEAKERS

10 VALVE HI-FI STEREOGRAM CHASSIS

Complete stereo unit comprising dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX speakers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles. **£49/15/-** F.O.R.

8 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo incorporating the "Mullard 2-2" amplifier circuit with separate bass and treble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 10,000 cycles. **£41/15/-** F.O.R.



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Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or minus 15 db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings.

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Dual speaker combination using the new Jensen M.S.P. 12PR woofer with matched tweeter and cross-over network giving a frequency response of 40 to 12,000 cycles. If required the Rola 12MX speakers can be supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are supplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial supplied in cream with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

COMPLETE RANGE OF DUAL, COLLARO, B.S.R. AND GARRARD, STEREO PLAYING EQUIPMENT IN STOCK

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specify **MORGANITE insulated** COMPOSITION **RESISTORS**

Type "AS" ½ watt, 5/32" x ⅜" long

Type "AY" 1 watt, 7/32" x ¾" long

Specify also:
MORGANITE CARBON POTENTIOMETERS

"E" series (miniature). "A" series (standard), 1⅛" diameter. Resistance, 1,000 ohms-5 megohms. Rating to 1½ watts.

RESISTANCE RANGE: Preferred values from 10 ohms to 10 megohms available ex stock, but range can be extended to both higher and lower values to your order.

ELEMENT . . . Moulded carbon composition.

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Type No. PT	ELECTRICAL DATA H.T. Secondary Volts	Max D.C. mA.	Rectifier Heater Wdg. V. A.	Other Heaters V. A.	DIMENSIONS Base Mounting B C	Overall D E	Overall Height F	Mounting Type	Weight lb. oz.	Effective Resistance per Anode Ohms	Valve Type	TYPICAL PERFORMANCE Fully Loaded. Input Cap. µF	Addit. R per Anode Ohms	R.M.S. Volts
1992	150-0-150	30	—	6.3 1.7	1-3 4 x 1-7/16	3-3/16 x 2	3-5/8	OCI 23	1 9	375	6X4 6V6	8 20	0 0	180
1993	235-0-235	50	—	6.3 3	1-3/4 x 1-13/16	3-3/16 x 3-1/2	3-5/8	OCI 23	1 14	300	6X4 6V6	8 20	0 0	225
2071	250-0-250	60	6.3 1	6.3 CT 3	3-3/16 x 3-1/4	3 x 3	3-1/2	VLN 31	3 7	345	6X4 6V6	8 20	0 0	250
2072	285-0-285	60	6.3 1	6.3 CT 3	3-3/16 x 3-1/4	3 x 3	3-1/2	VLN 31	3 8	290	6X4 6V6	8 20	0 0	300
*2073	300-0-300	60	6.3 1	6.3 CT 3	3-3/16 x 3-1/4	3 x 3	3-1/2	VLN 31	3 8	315	6X4 6V6	8 20	0 0	315
*1884	250-0-250	80	6.3 1 top at 5 3	6.3 2 6.3 CT 2	3-9 16 x 3-1/4	3-3/16 x 3-1/4	3-7/8	VLN 34	4 10	190	6V6 5Y3	32 8	0 0	200
1885	285-0-285	80	6.3 1 top at 5 3	6.3 2 6.3 CT 2	3-9 16 x 3-1/4	3-3/16 x 3-1/4	3-7/8	VLN 34	4 10	200	6V6 5Y3	32 8	0 0	225
1889	285-0-285	100	6.3 1 top at 5 3	6.3 2 6.3 CT 2	3-9/16 x 3-3/4	3-3/16 x 3-3/4	3-7/8	VLN 34	5 11	135	6CA6 5Y3	50 8	47 0	315
*1890	300-0-300	100	6.3 1 top at 5 3	6.3 2 6.3 CT 2	3-9/16 x 3	3-3/16 x 4	3-7/8	VLN 34	6 8	165	6CA6 5Y3	50 8	47 0	350
*1894	300-0-300	125	6.3 1 top at 5 3	6.3 2 6.3 CT 3	3-9/16 x 3-1/4	3-3/16 x 4-1/8	3-7/8	VLN 34	7 4	115	6CA6 5Y3	50 8	68 0	375
*1896	250-0-250	150	6.3 1 top at 5 3	6.3 CT 3 6.3 CT 3	3-9/16 x 3-1/4	3-3/16 x 4-1/4	3-7/8	VLN 34	7 4	70	6CA4 5Z3A	30 8	100 0	315
*1897	300-0-300	200	6 3	6.3 CT 3 6.3 CT 3.5	3 x 3-1/8	3-13/16 x 3-1/8	4-3 8	VLN 36	10 3	30	6Z3A 5R4	50 4	0 0	450
1783	410-0-410	180	6 3	6.3 CT 4 6.3 CT 9	3 x 3-3/8	3-13/16 x 3-3/8	4-3 8	VPH 38	10 13	95	6Z3A 5R4	50 4	30 40	450

FOR VOLTAGE DOUBLER USE

Type No. PT	D.C. Output Volts	D.C. Output mA.	A.C. Secondary Volts	Heater Windings V. A.	DIMENSIONS Base Mounting B C	Overall D E	Overall Height F	Mounting Type	Weight lb. oz.	Effect. Series Resist. Ohms	C — Condenser values R — Addit. series Resist. See Note (iii) below.
*2062	290 365	80	110 tap 100	6.3 CT 3.25	3-9 16 x 3-1/8	3-7/8 x 3	3-1/2	VLN 31	3 3	35	
*2063	340 315	55	133 tap 125	6.3 CT 2.25	3-9 16 x 3-1/8	3-7/8 x 3	3-1/2	VLN 31	3 3	79	
2064	340 315	125	125 tap 125	6.3 2.25 6.3 CT 3.25	3-9 16 x 3-1/8	3-3/16 x 3-1/2	3-7/8	VLN 34	4 15	16	C 100pf R 0
*2065	290 365	150	110 tap 100	6.3 CT 3	3-9/16 x 3-3/4	3-3/16 x 3-3/4	3-7/8	VLN 34	5 10	10	
2066	220 360	190	125 tap 105	6.3 CT 6	3-9/16 x 3	3-3/16 x 4	3-7/8	VLN 34	6 8	7	
1965	270	300	115	12.6 CT 5	3 x 3-7/8	3-13/16 x 4-7/8	4-3 8	VLN 38	9 14	4	C 100 pf R 3 ohms

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ON SHORTWAVE — By ART CUSHEN

MISSIONARY RADIO DOING WELL

Though it only began broadcasting last October, the Trans World Radio reports that its signals are being very well received in all parts of the world.

TRANS-WORLD RADIO has had an interesting history. For many years it operated as the Voice of Tangiers in Morocco, but, when the licence for all foreign operated stations was withdrawn by the Moroccan Government, it was forced to find a new home. The present transmission from Monte Carlo has some interesting points. The actual transmitter building was built by Hitler in the early 1940s, high on the hill overlooking Monaco with the idea of using it to spread Nazism around the world, but the station was never completed. The 100,00 watt transmitters were ordered by the Indonesian Government, but funds were limited and the plan collapsed.

The board members of Radio Monte Carlo agreed that the Voice of Tangier move to Monaco and use the frequencies assigned to that country for overseas broadcasting. The cost of the half-million dollar project was met by donations, and so the first full time missionary station in Europe was built.

The new 100,000 watt transmitter uses five 300 foot towers to beam an estimated 1,600,000 watts of effective radiated power, as strong a signal as the B.B.C. or V.O.A. transmitters.

The gospel broadcasts are now more able to penetrate into the heart of Russia than from Tangier, being 1,000 miles nearer the main target of the broadcasting aim of Trans-World Radio.

The situation of the station in Europe means that Trans-World Radio is able to provide excellent programs and signals to an audience with over one-half of the radio sets in the world outside the United States, long the prime target area of many missionary broadcasts. The station is best received in this area on 9710Kc with English from 4.30 to 6.00 p.m.

Further tests from Trans-World Radio are being heard on 7197Kc at 7.00 a.m., and a request for reception reports from listeners throughout the world is made. These should be addressed to P.O., Box 141, Monte Carlo, Monaco.

The station has also been noted by Dick Pollard, of Nelson, N.Z., using 11,850Kc, and this test transmission is heard from 3.00 p.m. A further test is noted to Scandinavia on 9,705Kc from 4.00 to 5.00 a.m., and the programs are in Norwegian and Swedish each for 30 minutes.

Katanga using 11,867KC

THE reception of Radio Katanga in the former Belgian Congo has been heard in various parts of the world over recent months, and now in this area good signals from the station have been heard. The Katanga station is using 11,865Kc., and is best after Berne in Switzerland leaves the frequency at 3.00 p.m. At this time the station identifies and, following a march, news in French is read to 3.15 p.m. Following this an uninterrupted musical program is presented to 4.00 p.m.

The latest information is that Radio Katanga is expected to have new 20Kw. and 50Kw. transmitters installed shortly, when the station will begin transmissions in foreign languages, especially in English. The address for reports is P.O., Box 1152, Elizabethville, Katanga, Congo.

CBS serves Africa

A NEW transmission from Radio Canada in Montreal is now being carried over the Sackville transmitters for listeners in Africa. The former European section has been cut into two portions and the African service in English and French has been inserted. The African service is from 4.30 a.m. to 6.00 a.m., with English 4.30 to 5.15 a.m., French from 5.15 to 6.00 a.m. The European service is now broadcast, 9.25 p.m. to 4.30 a.m., and then from 6.00 a.m. to 7.35 a.m. The Africa service is carried on 17,820 and 15,320Kc. The service to Australia and New Zealand remains unchanged from 6.25 to 7.05 p.m., and is carried on one frequency, 9,630Kc. Reports from listeners are welcomed by the Canadian Broadcasting Corporation, Box 6,000 Montreal, Canada.

Belgrade using 15,240Kc

EXCELLENT signals from Radio Yugoslavia in Belgrade are heard at present on 1,524 Kc, with a session in English, broadcast from 1.00 to 2.00 a.m. daily. The station is using three frequencies for this transmission, 9,505, 11,715 and 15,240Kc. The later channel is strong with no interference, 11,715Kc is fair, but jamming and a weak signal on the same frequency spoil otherwise good signals and the other frequency of 9,500 Kc is only fair. The program on Friday morning includes answers to letters from listeners and request music. A further English transmission from 2.45 to 3.00 a.m., is on the air on 7,200, 9,500 and 15,240Kc.

Readers report

INCLUDED in the mail from several of our readers is an interesting report on reception from Stephen Thurlow at Cabramatta, N.S.W. Ankara in Turkey at 11.45 p.m. on 15165 Kc., Lisbon at 11.47 a.m. on 15150Kc., Nairobi Kenya at 3.15 a.m. on 4855 Kc. Belgrade on 15240Kc at 1.40 a.m. in English, Vatican on 21510Kc. at 2.00 a.m. with a report in English, and HLK5 in Seoul at 2.20 a.m., when English was also broadcast, on 9640 Kc.

DZ19 on 7250Ks

THE relatively new frequency for the Far East Broadcasting Company in Manila of 7250Kc. is being received at good strength with a program in Chinese to sign off at 3.00 a.m. The station when closing lists its complete network, which broadcasts from Manila in the Philippines over stations DZB2 3345 Kc., DZH6 6030, DZH7 9730, DZH8 11850, DZF2 11920, DZH9 15300, DZF3 15385, DZ16 17800, DZ18 21515 and DZ19 using 7250Kc. The station when closing asks for reports from listeners and promises a verification card and personal letter, the address being P.O. Box 2041, Manila, Philippines.

Port Moresby broadcasts

THE recent clearance of signals from 9520Kc in the afternoons has resulted in wider reception of the signals of VLT9 at Port Moresby, New Guinea, which is on the air with relays of the 9PA transmissions. The complete schedule of the station, which uses two frequencies and a 2,000 watt transmitter, is as follows.

Weekdays 6.00 to 8.00 a.m. and 5.00 to 11.30 p.m. on VLT6 6130Kc.

Weekdays, 8.15 a.m. to 4.45 p.m. on VLT9 9520 Kc.

On Saturday the schedule is extended to sign off at midnight while on Sundays the transmission does not commence till 6.30 a.m. The station is operated by the Australian Broadcasting Commission, and recently it was announced that

ART CUSHEN ON RADIO N.Z.

A NEW feature has been added to the program "This Radio Age," which has been broadcast from Radio New Zealand in Wellington for the past 10 years on a monthly basis. The program, which is compered by Cleve Costello, is on the air each first Wednesday of the month at 6.10 and 8.30 p.m. using 6080 and 9540 Kc. The new feature of DX information is supplied by your Shortwave Correspondent Arthur Cushen and is recorded in Invercargill for broadcast from the Wellington station. DX tips of specific interest to listeners in Australia and the Pacific area are included in the 12-minute session each month.

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Most parts used in the Transporta Four can be used for the Transporta Seven should a larger set be required at a later date.

NEW GV RECORD PLAYER £8/15/

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Postage and packing extra.
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47/6 Packing extra. Post, N.S.W. 10/-; Interstate 12/6.

9in x 6in OVAL SPEAKERS

27/6 Post, N.S.W. 7/6; Interstate 11/6. Plus packing.

Transformers for above speakers 5,000 or 7,000 ohms, 10/-.

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt, at 4 amp., 37/6.
Post, N.S.W., 7/6; Interstate, 10/-.
Transformer for above rectifier tapped for 6 or 12 volt, with circuit for charger, 47/6.
Post, N.S.W., 7/6; Interstate, 10/-.

As above, 6 or 12 v. at 2 amp., 27/6.
Post: N.S.W. 3/6. Interstate 4/6.
Transformer for above, 37/6.
Post: N.S.W. 3/6. Interstate 4/6.

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two 10kw stations would be in operation in Port Moresby replacing the present station.

Broadcasts from Congo

RADIO Leopoldville in the Congo continues to be heard at good strength in its various language transmissions, using 11755 Kc. The latest reception covers signals from 3.30 to 7 a.m., with a news bulletin in English read at 6.00 a.m. A program in German is given at 6.30 a.m. and on Sundays a listeners mailbag session is on the air at 3.30 a.m. Programmes in French include a news bulletin at 5.30 a.m.

Swiss changes

THE Swiss Broadcasting Corporation at Berne has made some additional frequencies available for some of its services and the new ones now on the air are as follows:

Australia and New Zealand, HE19 21605 Kc. 5.15 to 7.00 p.m.

Western Australia, HEU7 17720Kc. 7.00 to 7.45 p.m.

South East Asia and Japan, 10.45 p.m. to 12.30 a.m., HEU7 17720Kc, HE19 21605 Kc.

English from Hilversum

THE English broadcasts from Radio Netherlands in Hilversum in Holland are now broadcast on the following schedule:

8.00 to 8.50 p.m. Australia and New Zealand 21480, 17775 Kc.

Midnight to 12.50 a.m., South Asia, Africa 15445, 25610 Kc.

7.15 to 8.05 a.m., Europe and North America 11730, 9590 Kc.

11.30 a.m. to 12.20 p.m., North America 9590, 6025 Kc.

VLE Melbourne

FOLLOWING the announcement made during the 21st anniversary of Radio Australia that two 100 Kw. transmitters VLE and VLF would come into service in 1961, the VLE transmitter came into service early in the year. This transmitter carries the usual Radio Australia programs and in most cases replaces lower powered transmitters on the same frequency. The transmitter is at present using three frequencies 15240, 15180 and 9580Kc.

VLE15 15240Kc 6.58 to 9.00 a.m.
VLE15 15180 3.59 to 7.45 p.m.
VLE9 9580Kc 7.58 p.m. to 3.30 a.m.

Flashes from Everywhere

SINGAPORE in its broadcasts on short-wave is testing a new transmitter, and is scheduled to use 7250, 6115 and 4820 Kc. The initial test has been heard on 7250 Kc. from 8.30 p.m. to 12.30 a.m., with the first hour in Tamil, then Chinese. English is carried from 10.30 to 11.30 p.m. with a ten-minute news service at 10.30 p.m. and the final hour is broadcast in Malay.

ANGOLA station, Radio Diamang at Dondo, has been noted on 9475 Kc. by a North American listener. The station, which is owned by an Angola diamond company, and is on the air for the entertainment of its employees, left the air at 5.30 a.m. after the playing of the Portuguese National Anthem.

LUSAKA is using 9577 Kc., reports Radio Australia, and is heard from 3.00 to 4.00 p.m., but in this area suffers considerable interference.

TUNIS has replaced its 11970 Kc. outlet by one on 9505 Kc., and a Swiss report lists the transmission time from 11.00 p.m. and again from 5.00 a.m. and 9.00 a.m.

MALAGA in Spain in the Radio National service carries its broadcasts on 6182 Kc., and is heard from 3.00 a.m. to 10.00 a.m.

JOHANNESBURG in its Africa service has replaced the frequency of 15,265 with 15,300 Kc. The station is also using 17,855 Kc. and from the latter frequency best reception is from 3.30 to 6.00 a.m. and on 15,300 Kc. the service is best from 6.00 to 7.00 a.m.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

KARACHI, in the broadcasts of Radio Pakistan, is heard from 7.30 to 7.45 p.m. on 21,590 and 17,745 Kc., and again from 1.30 to 1.45 a.m. on 11,672 and 9645 Kc., both these sessions are in English.

TEHERAN, with its session in English at 6.45 a.m., now uses 7047 Kc. instead of the announced 7285 Kc., which has been dropped.

SPANISH GUINEA is the location of a station heard with weak signals on 6240 Kc. for several weeks. A report from the Swiss DX session says that this transmission is heard in Europe, suffers from very severe interference and has at last been identified as Radio Santa Isobel, in Spanish Guinea. The station is broadcasting on this frequency on a daily basis and is heard from 4.30 to 6.30 a.m.

KATANGA at Elisabethville in the Congo is giving fair to good reception on 11,865 Kc., the same frequency as used by Berne, Switzerland. It has been heard in this area from 3.00 p.m. and again from 2.00 a.m. to 7.00 a.m., with French programs on 4.00 to 5.00 a.m. The station gives frequent announcements in both English and French throughout the transmission.

CONGO Republic, the former French territory, is being heard via Radio Brazzaville, which uses 5970, 9775 and 11,725 Kc., with news in French at 5.00 a.m. At 4.10 a.m. the Brazzaville station has a news bulletin in English, while a further transmission for Madagascar is on the air from 6.30 to 7.55 p.m. This time the frequencies are 15,444 and 21,500 Kc., with news in French at 7.00 p.m. and in English at 6.30 p.m.

CAIRO, in its transmission to Europe, has not been heard in recent weeks due to a poor frequency assignment, but has now come up on 11,915 Kc. The service is on the air 5.00 to 8.30 a.m., and th last hour of the program is carried in English.

LIBERIAN station ELWA, at Monrovia, which we have reported in the past as being heard to 6 a.m. with English on 15,085 Kc., has extended its transmission with a service beamed to North Africa. The broadcasts on 15,085 Kc. are in French, Portuguese, and local dialects, and are on the air from 6.15 to 8.00 a.m.

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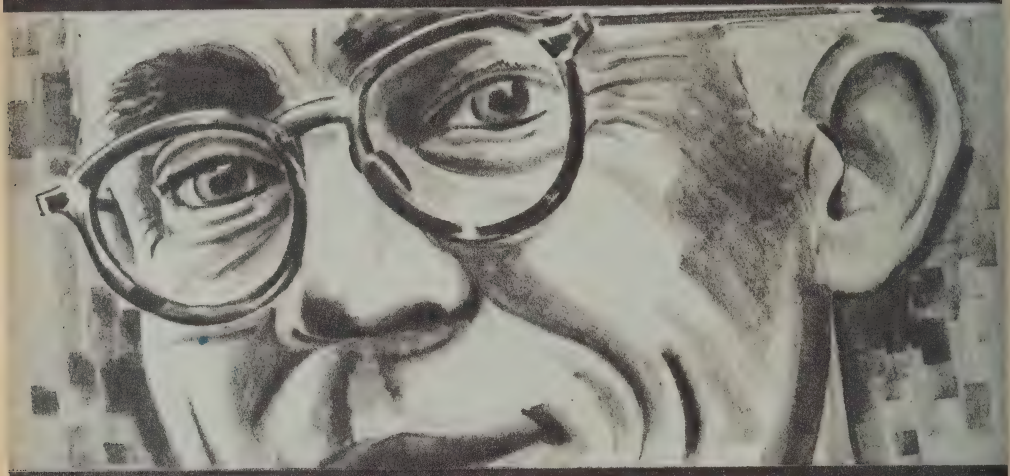

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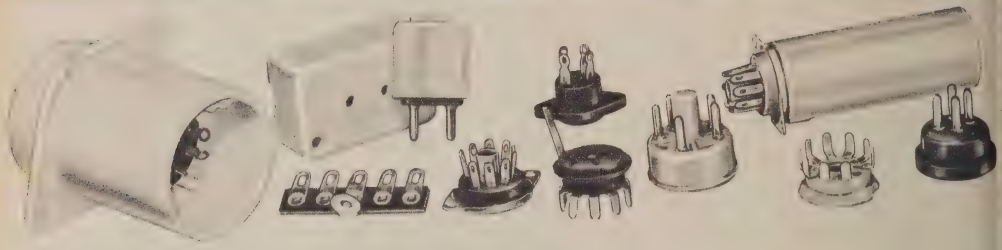

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ANSWERS TO CORRESPONDENTS

WIDER COVERAGE FOR AN OLD SET

S.G. (Seacombe Gardens, S.A.) writes hat he has an old commercial dual wave eceiver, tuning from 6 to 22 Mc/s on he short wave band. He asks if it is ossible to add to this set in order to eceive higher and lower bands, and whether it would be possible to receive M in some way.

A.: The fact that your set has a hort wave band does not make much ifference when one wants to add to its anges. This is because most converters re made to work directly into a stanlard broadcast set, using it in effect as n IF amplifier and detector, etc., at bout 1500 Kc/s.

Most of the simple converters of this ype, such as the "Two Band Converter" vhich we described in July, 1955, would robably cover much the same bands as our present set and would thus offer ittle in the way of increased coverage. Iowever, the advantage of the double onversion set so produced, in the way f selectivity and image rejection, would e appreciable.

As for increased coverage, you may nd some benefit in the use of converrs along the lines of the "144 Mc/s Converter" of March, 1953, and the "50 Mc/s Converter" of March, 1959. These onverters are intended for operation on single, rather narrow band, and therefore may not fully satisfy your needs as ney stand.

Reception of FM, unfortunately, is ather out of the question with this set. The best which could be done is to uild an FM tuner, and use the audio ection of the set in conjunction with the uner. We know of no converters to nable the set to receive FM on any ther basis.

J.McN. (Alphington, Vic.) asks if we ave considered publishing details of a mall transistorised TV receiver, conidering the present availability of transtors and subminiature components.

A.: We may publish such a design in he remote future, J.McN., but as yet e have no plans for such a unit. Despite the current availablity of many parts, a number of specialised components required for television sets are, s yet, unavailable. Transistors for HF tuner and sweep circuits are, if vailable at all, extremely costly. So you an see that there are still a few more urdles in the way of such a project.

J.W. (Oaklands, N.S.W.) asks us for uggestions on how to improve the eble response of his guitar amplifier hich he constructed from the article in he December, 1954, issue of the magane.

A.: We are rather surprised at your quest concerning treble response as we ave not received any previous inquiries n this regard. We suggest a thorough heck of the wiring, components and, deally, amplifier response. If this does ot reveal the cause of the trouble, you ould try the following experiments.

By removing the tone control from he circuit the treble response may be mproved slightly, or reduction in the value of the .05 mfd. coupling capacitors will reduce the bass response. Again, a small value capacitor bypassing the feedback line will reduce the amount of treble feedback and thus increase the gain at the higher frequencies.

Do not lose sight of the possibility that your guitar pickup unit may have poor response to the higher notes.

L.C. (R.A.A.F., Ballarat, Vic.) wants to know if it is possible to purchase a complete Playmaster Control Unit No. 10 from commercial sources and also if the parts are available separately to enable the unit to be constructed at home.

A.: Yes, L.C., the control units are available from a number of our advertisers as a completed unit and almost any radio supply house should be able to provide the necessary parts should you desire to construct the unit at home. We suggest you contact the advertisers direct and obtain specific information from them as regards price, etc.

P.D. (Miranda, N.S.W.) sends us the details of a reversing system which could be applied to the Carrier Control unit for model trains, which was featured in the April, 1960, issue.

Thanks for the suggestion, P.D. We ourselves had considered a unit of this type, using a second carrier to actuate a relay which reverses the motor. However, as you mention, we considered that there would be insufficient room in the trains for relays and additional circuitry. If there is evidence of further interest in this subject by more readers, we will endeavour to incorporate this and other ideas into a second article on the subject.

D.W. (Merrylands, N.S.W.) asks if we are considering designing an electronic photo-flash unit suitable for colour photography. He feels that there may be other readers interested in such a project as well.

A.: We have published a number of electronic flash circuits in the past, O.W., suitable both for portable and fixed operation. A high power 100-joule version appeared in the September and November, 1952, issues of the magazine and a lower powered version in the April and May, 1956, issues. Guide numbers were also worked out for the higher power unit suitable for colour work, being approximately 28 for Kodachrome type film.

J.McD. (Bowden, S.A.) writes to extend his personal good wishes to the Editor and staff, then goes on to emphasise his interest in all types of organ—pipe, electronic and reed.

A.: Thank you for your good wishes and for your interesting comments about organs. We are glad that you so appreciate articles by the Serviceman and Calvin Walters.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

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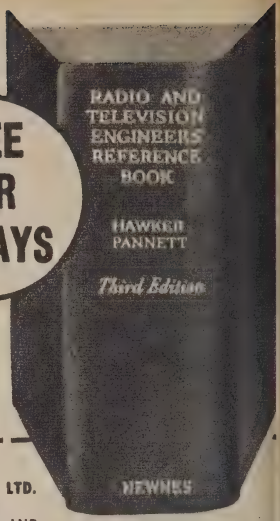

IN THIS NEW EDITION many recent developments have been covered for the first time, and numerous sections completely revised or recast to take the latest techniques into account. For example, the rapid progress and increasing application of semi-conductor devices are reflected in TRANSISTORS, providing basic information on the latest types. Modern semi-conductor applications are discussed in such articles as TRANSISTOR D.C. CONVERTERS, GERMANIUM AND SILICON POWER RECTIFIERS, TRANSISTORIZED BROADCASTING RECEIVERS, SERVICING TRANSISTORIZED EQUIPMENT, ZENER DIODES, etc. The practical use of transistors in modern transmitters is dealt with in the enlarged COMMUNICATIONS TRANSMITTERS section which also includes new material on low power single sideband transmitters, choice of quartz crystals, v.h.f. scatter and meteor burst communication systems.

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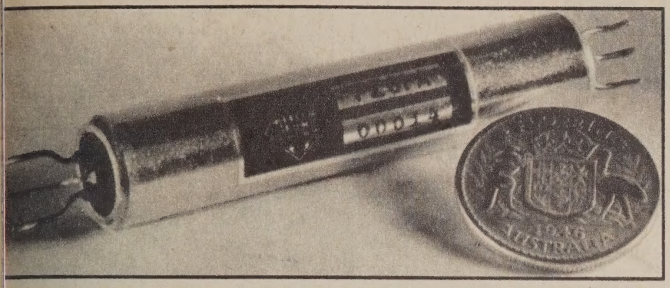
NARROW BAND-PASS IF FILTERS

(Continued from Page 69)



Here is a typical mechanical filter of European origin. Some idea of its size can be gained from the Australian florin placed alongside it.

etter than 2 to 1. It weighs only 1¼oz nd measures 3in long by 5/8in diaeter.

While this unit would not be of much se to us in our search for a bandwidth f 3 Kc, overseas companies have for ome time been manufacturing filters vith a centre frequency of 455 Kc and andwidths varying from 200 cycles to 2 Kc.

In the past these units have been difficult to obtain, as they are only brought nto the country on special order. However, a well-known European company s releasing a range of these filters on 455 Kc which should be available within the next few months.

The units have two output tappings and can be matched into either valve or transistor circuits, whichever is desired.

Summing up, then, we may consider that there are three main types of filters. Which type you decide to use when modifying the station receiver, or constructing a new receiver, will depend largely on how much money can be spent on the job, the amount of space available, and how much work you are prepared to put into the project.

For a number of reasons, filter networks such as those described should be placed in circuit immediately following the mixer valve. Positioning them further along the IF line will only reduce their effectiveness.

Next month we hope to feature a filter based on the design shown in fig. 4 of this article. This filter is currently under development in our laboratory and will have a centre frequency of 455 Kc.

REFERENCES

AWA technical review Vol. 10, No. 1, pages 5 to 9. Radio Engineers Handbook by F. E. Terman, pages 230 and 231. Single Sideband for the Radio Amateur by the ARRL, pages 42 to 52. New Sideband Handbook, by Don Stoner W6TNS, pages 60 to 62.

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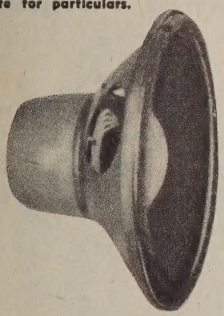

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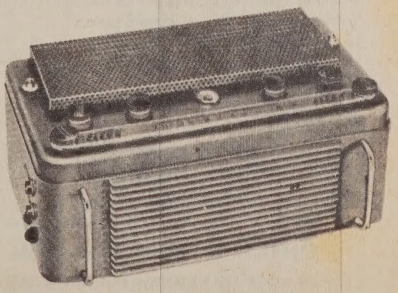

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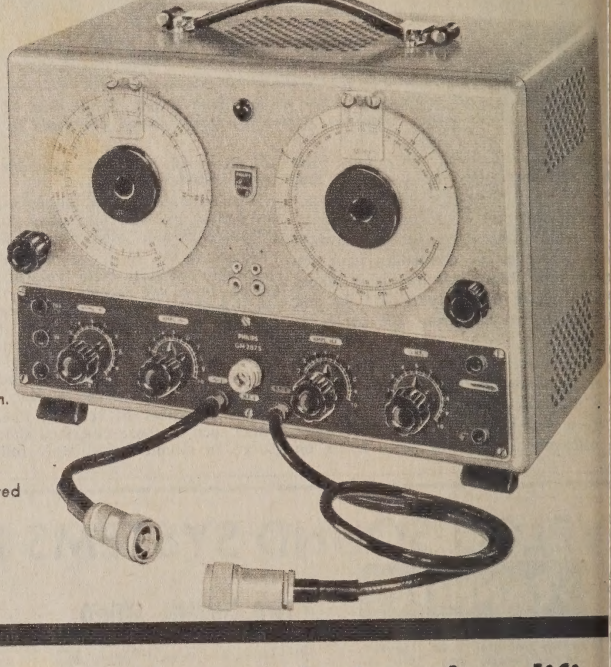

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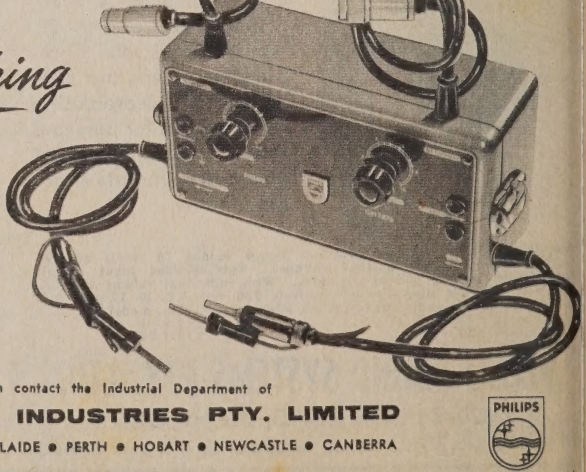

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EXPLORING CAVES

(Continued from Page 15)

straight out the air current is in the same direction.

If it flows through and into a well or "sump" the air flows in the same direction at the water surface and in the opposite direction at the roof.

Some caves have only two entrances at different levels. In summer time, the air is cooler in the cave than outside and will flow down from the upper to the lower level. In winter the reverse takes place with the air outside colder than inside so that the air flows from the lower to the upper level. This is why speleologists search for new caves like this in the winter for draughts coming out of holes can indicate a two-entrance cave system.

BAROMETRIC PRESSURE

By studying the barometer, a speleologist can often determine when is the best time to search for cave entrances. If the barometric pressure outside falls, air will come up out of the cave causing a draught at the surface. The size of a cave is indicated by the extent of the draught at low pressures.

The study of the water flow in caves gives important clues as to the extent of the system. Water varies in temperature as it flows through various formations. When water enters the cave it is not at the same temperature as the interior of the cave, but it flows only a short distance before it reaches the cave temperature.

Thus, by measuring the temperature of, say, a spring which emerges from the ground, it can be determined whether it comes from a large underground system or is a local spring.

Water flow is also studied by introducing detectors into the water and tracing their emergence at some other point. The most popular detector is a substance called fluorescein, an organic chemical which shows a green fluorescence when exposed to light.

It can be detected in water at a dilution of one part in one hundred million, is harmless even if introduced in this dilution into drinking water.

When water disappears into the ground at places called "sinks" it may flow underground for long distances. Springs some miles away may be this self-same stream emerging to the surface.

LIGHTNING HAZARD

An interesting aspect of cave physics is the fact that the ionisation and conductivity of cave air is higher than outside on the surface.

Consequently speleologists in stormy weather avoid the entrance to a cave like they would the plague. Lightning will strike to earth at points of higher conductivity so that it is a frequent occurrence in certain areas for the entrances to caves, particularly the "pothole" entrance at the surface, to be struck by lightning.

Cave explorers, especially the modern kind, are particularly well equipped for the job in hand. It must be remembered that exploring a cave is a similar operation to climbing a mountain. You climb down and then up whereas the mountaineer climbs up and then down. The same type of equipment is needed in both cases, ropes, spikes, proper footwear and so on.

In addition to this and distinct from the mountaineer, the speleologist may have to crawl through narrow passages illuminated only by artificial light which he must carry.

Then again, the speleologist must be prepared to swim underground streams, some of which are at icy temperatures. For this he must have special equipment and, as he may have to swim underwater for considerable distances, he must be equipped with oxygen cylinders and the usual skin diving equipment.

He must be equipped with means of communication. This often is a walkie-talkie and field telephone equipment.

Some expeditions carry portable rubber dinghies usually of the inflatable kind used by the R.A.A.F. These are useful in cases where large pools or lakes are found underground.

One of the most dangerous hazards of underground exploration is losing the way in a maze of passages. Accordingly it is essential to leave marks upon the walls or floors so that the way back can easily be recognised or those who may follow can trace you, should an accident occur which prevents you returning at the predetermined time.

Very few explorations are carried out alone. The job is done by parties to a set program.

It is very often the case that most beautiful formations are found in large caves and the trained speleologist will make sure that these are not spoilt in any way by breaking or walking upon.

There are some unusual phenomena in underground caves which are rather confusing to the unitiated. The slightest sound may appear to be magnified tremendously in the deathly silence.

There is a case on record where the heartbeats of an exhausted companion some distance away terrified the others by the thumping sound until the source was discovered.

Optical illusions are common, so that a small recess may look like a great chasm or a small pool a great lake. Depths of pools are deceiving. Because of the crystal clear water a pool seemingly only a few inches deep may be many feet and many a wetting has been taken by the uninitiated.

There is a tendency for the eye to prolong anything that disappears into darkness and it has been found that inexperienced people usually multiply distances by ten. For this reason even professional explorers often have to measure to make sure they are not mentally exaggerating.

For those who wish to study the subject further I can recommend "British Caving" an introduction to speleology by C. H. D. Cullingford and "Caves and Cave Diving" by Guy De Lavaur.

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